SCIENCE

FRIDAY, MARCH 29, 1912

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

THE CARNEGIE FOUNDATION FOR THE ADVANCEMENT OF TEACHING[1]

IN March, 1911, Mr. Andrew Carnegie transferred to the trustees $1,000,000 of five per cent. bonds of the United States Steel Corporation, the first instalment of the gift of $5,000,000 offered in his letter of March 31, 1908.

This amount brings the funds at present in the hands of the trustees to a total of somewhat over twelve millions of dollars, of which eleven millions are invested in five per cent. bonds of the United States Steel Corporation and approximately one million, the result of accumulated surplus, is invested in other securities, purchased upon the approval of the finance committee and listed in the treasurer's report.

The total income at the disposal of the trustees for the fiscal year just ended amounted, as shown in the treasurer's report, to $590,449.54.

The total expenditures of the trustees were distributed as follows:

Retiring allowances and pensions in accepted institutions—		
Teachers	$341,899.16	
Widows	46,720.17	$388,619.33
Retiring allowances and pensions to individuals—		
Teachers	$122,215.10	
Widows	16,044.57	138,259.67
Salaries, publication, rent, etc.		53,564.21
Total expenditure		$580,443.21

. . . .

[1] Extracts from the sixth annual report of the president, Dr. Henry S. Pritchett.

In the report of last year I sought to call the attention of the trustees and of teachers in colleges and universities to the specific things that a retiring allowance system could do, and also to the limitations of such a system. The experience of the past year prompts me to refer again to these limitations, and to the extreme difficulty of making exceptions to the rules framed for administering the income of the foundation.

The specific things that the system of retiring allowances maintained by the foundation offers to the college teacher are three in number: (1) a fair retiring allowance after sixty-five years of age; (2) a disability allowance after twenty-five years of service as a professor, in case of a failure in health so complete as to unfit him for his work as a teacher; (3) the payment to the widow of a professor who has had twenty-five years of service, of a pension equal to one half of the allowance he would have been entitled to at sixty-five. I am inclined to think that the protection of the wife and family thus provided is the most valuable and, in many cases, the most highly appreciated service that the system of retiring allowances can render. These benefits accrue to the teacher under specific rules, according to which he himself and the officers of his college may know, quite as well as the officers of the foundation, whether he has had a service which makes him or his widow eligible under these rules.

The executive committee of the foundation has spent much time over cases which, falling outside of these specific provisions, are urged upon their attention by college authorities, by friends of those desiring relief and by the applicants themselves.

These requests are justified in part by the action of the trustees in giving to the executive committee permission to extend the benefits of the retiring allowance to certain exceptional cases—notably to men who desire to devote themselves to research, and to college executives who have rendered noteworthy service. As a matter of fact, the executive committee has never made use of this authority granted by the trustees, and I am convinced that the difficulties of making such exceptions are so great that the committee will find it necessary to abide wholly by the fixed rules.

The idea of giving, by the granting of a pension, opportunity to men of proved ability to devote their whole time to research was a very attractive one to the trustees and officers of the foundation at its inception. It was felt that a by-product of the retiring allowance system which would be of great value might here be obtained.

Unfortunately, experience has not justified this hope. This is due to a number of causes: partly to the fact that there are yet few men in the colleges and universities engaged in advanced research; partly to the tendencies of the colleges themselves and to the qualities inherent in human nature. Experience shows that under the encouragement offered by this action of the trustees, a considerable number of teachers who had done nothing in research hitherto suddenly discovered that they had a mission in that direction. Further, the college authorities were ready in many cases to recommend as qualified for research professors whom they had found ineffective as teachers. Finally, in the cases of men genuinely interested in research and prepared to undertake it effectively, there is some question whether such provision by the foundation would not weaken the sense of responsibility among the colleges toward research and those undertaking it.

The experience of the foundation in considering special cases among "those whose twenty-five years of service include noteworthy presidential or other administrative work in a college or university" has

brought out still more strongly the difficulty of making exceptions. Every college president considers his case an exception, and all of his friends consider the record of his services as noteworthy. A board of trustees dismissing a college president to make way for a new man will in most cases certify in the highest terms to the extraordinary character of the departing president. It is very true that most such men have given to their work a high order of devotion and of disinterested service; no college presidents are more deserving than some of those that are forced out by their boards of trustees. On the other hand, it is practically impossible to compare the records of such men and single out a few for recognition without doing great injustice to others. The hardships of college presidents—aside from those that arise from their own failings—come from the defects and the crudeness of our comparatively young educational system. Part of these are due to an over-production of colleges and consequently of college presidents. Compensation for such inequalities can not be brought about by the action of a pension agency. The cure must come from a gradual improvement in our educational organization, and a more enlightened attitude on the part of the public and of college trustees toward those who are responsible for educational administration. It is as difficult to select the especially deserving president or dean as to select the special teacher whose work has been of noteworthy character. The effect of such legislation by the trustees has been to arouse hopes on the part of many presidents that they might in case of such an emergency as dismissal from office be considered in a special class entitled to the receipt of a retiring allowance. The experience of the past five years shows that the administration of such a rule is impracticable.[2]

Other requests and recommendations that come to the executive committee cover almost all possible variations from the rules. The most common are those in which the teacher has served for a shorter period than twenty-five years and suddenly breaks down in health or dies leaving a helpless family. These are indeed the most pathetic cases that one can meet. Here again, however, a little reflection will show how impossible it is to go outside of the established rules without embarking upon an entirely new pension system. Again, it is impossible for a pension system to take care of individuals who neglect to use reasonable prudence in the affairs of life. The teacher's salary is often pitifully small. To provide even modest insurance against the death of the breadwinner seems often too great a burden to add to the already heavy load. Oftentimes, too, the men who are thus cut down early are those who have thrown themselves into the service of education with a splendid enthusiasm, and sometimes with a reckless disregard of their own health and of the claims of their fam-

[2] At the meeting of the trustees, November 15, 1911, the action which empowered the executive committee to make exceptions in the cases of "those whose twenty-five years of service include noteworthy presidential or other administrative work in a college or university" was rescinded. No person has ever been retired under this authority. The only exceptions to the rules now recognized by the trustees are in the cases of men of proved ability in research, who would in the judgment of the trustees be able to render unusual service to science if free from teaching duties. Such cases will be extremely rare. Experience shows that research in general flourishes in the contact of investigator and student. No retirement has as yet been made under this provision. Such action would mean in any case the highest recognition the trustees could render of their appreciation of ability already demonstrated and of their expectation of still higher achievement to follow.

ilies. There should be somewhere some provision for such cases. But it is clear that the just remedy for such exceptional misfortune does not lie in a disregard, on the part of those administering the present pension system, of the rules established for the welfare of all. Some, at least, of these cases should be met by the colleges.

. . . .

The presence of the altruistic spirit among college teachers is strong, but perhaps no stronger than among other classes of educated men. As in every calling, a large number of those in the profession of the teacher are drawn to it by bread and butter reasons. The offering of a pension can not fail in some cases to minister to the selfish side of human nature. There will always be some who, when they find themselves in possession of a given advantage, whether that take the form of a benefit in the hand or one to be acquired in the future, will trade upon the possession or the prospect of that benefit. Under the present rules there will be a certain number of teachers who will count the years and the days until the coming of the minimum age which enables them to resign the duties that they now perform in a perfunctory and machine-like way. There are still other men facing responsibilities and difficulties in administrative places or in teaching who would gladly use the method of the pension to escape from the perplexities and responsibilities of their positions. Presidents are prepared to prove to the foundation, even when they are turned out of office by the trustees for alleged incompetence, that they are entitled to a pension on the ground of extraordinarily meritorious service. Too many teachers, too, think that they are entitled to consideration of a special sort by reason of their particular and unusual service. All this arises out of the qualities of human nature, and out of the qualities of some of the men who to-day make up the faculties of our colleges. On the whole, the number of those whose selfishness is directly touched by such an opportunity is small, as small perhaps as one ought to expect, and in the long run much of this spirit will disappear as the teachers themselves become accustomed to a system of pensions. In time teachers will realize that it is for their own interest and in the direction of their own happiness to continue to work as long as they are really fit and able to serve. The late William T. Harris always insisted that a college professor was at his best between the ages of sixty-five and seventy, and he strongly urged the trustees of the Carnegie Foundation at the inception of the trust not to make the minimum retiring age lower than seventy. Mr. Harris's argument was a partial one, but it had some truth in it. There are many teachers who are at their ripest and at their best between sixty-five and seventy-five, and such men ought, of course, to remain in their profession. In the long run it will be found that they will do so, although for a few years the idea of the pension will induce some men to surrender work at an earlier age than they ought. It is impossible to offer to men an advantage such as that which flows from a pension system of any sort without arousing in some minds the question, How can I get the most out of it? The number of such individuals among college teachers, however, is small, and will, unquestionably, become smaller as the standards of college life rise.

Nor can one shut one's eyes to the fact that the colleges themselves may, by reason of the pensions of the foundation, neglect their own duty in taking care of their old teachers. This also, in my judgment, is a temporary and passing phase of the situation. The officers of the foundation have

done all in their power to make it clear to the colleges that the funds at their command, and likely in the future to be at their command, could care for only a limited number of colleges. Nevertheless, in spite of this effort, it has been tacitly assumed by many colleges, and generally by those of the lowest standards in scholarship, that any obligation on their part to care for their old teachers vanished with the inauguration of the foundation.

Notwithstanding the disadvantages, however, that must occur in the administration of any such system of these pensions, it seems clear that the advantages that have resulted from the conferring of pensions have greatly outweighed the disadvantages, and that, furthermore, the advantages on the whole seem likely to become stronger with time, while the disadvantages tend to diminish. The value of a pension system depends not only on those who administer it, but no less on the spirit and *morale* of those who are to participate in its benefits. The dangers of a non-contributory system lie mainly in those universal dangers that come from human weakness and human selfishness.

It is, to my thinking, a fair question whether college pensions ought not, like other pensions, to carry a contributory feature. No one can be more sensible than I of the tremendous demands made upon the meager salaries of the American college teachers, and yet notwithstanding this, it is impossible to remove the college teacher from those social and moral influences that affect all men. The experience of the world seems to make clear the fact that on the whole a contributory form of pension is likely to be most just and least harmful.

The sacrifice of the individual to which I have referred is directly connected with the question, "What obligations rest upon a college to care for those who have grown old or have broken down in its service?" This question is rendered more urgent by the establishment of the Carnegie Foundation. In every report of the foundation attention has been called to the fact that the income that it is likely to have can provide at most for only a small minority of the college teachers of the country. All that the trustees can hope to do is to establish the principle of a generous and fair retiring allowance system as a part of the régime of higher education in the United States. The question, What is the duty of the college in this matter? still remains, even to a considerable extent, in the accepted institutions. In these institutions the main burden of pensions is carried by the foundation, but the obligation of these institutions to care for those who have served them well, and who are not eligible to retirement under the foundation, still remains.

The question as to the duty of the college is, of course, only part of a larger question that all organizations in the social, educational and industrial circles of our country are now facing. The relation of a pension provision to efficiency and the obligation of a corporation to its servants is being discussed to-day from every point of view. The college must face this question just as other corporations are facing it. One does not need to be an extreme individualist to realize that the individual is too often sacrificed to the service of the corporation. Perhaps in no form of organization is this more often true than in the colleges. We need constantly to be reminded that colleges, as other human organizations, were made for men; men were not made for colleges. The obligation rests upon every organization in the social order to deal fairly with the question, how far it is accepting the sacrifice of the individual in order to promote the organization, or the

cause that the organization is supposed to serve.

This question presents itself in a very acute form in our colleges. A large proportion of the colleges overwork their teachers in the effort to take more students or to teach more subjects. College loyalty is constantly invoked to justify the placing of an additional burden on the shoulders of an already overworked teacher, and college loyalty looks less frequently to thoroughness and quality than size. Under these circumstances, is there not a clear duty resting upon the college authorities to use part of the income in their hands in the support of those who grow old or break down under this régime?

There is a widespread tradition that corporations have no souls. But of all soulless corporations, the colleges probably have the smallest compassion so far as the question of dealing with their old servants is concerned. Few business corporations would be as heartless toward an old officer as a very large proportion of American colleges are. In the most of these, a worn-out president, an aged professor or a teacher struck down by illness is simply turned out to shift as best he may. In fact, the college trustee has been surrounded by such influences that he invokes his responsibility as a trustee to justify the plea that under no circumstances can he use any of the income of the college, whether from endowment or tuition, to care for those who break down in the college service. It is exactly here that the question of the duty of the college arises. Has any corporation the right to use the service of individual men of high devotion and intelligence up to the end of their working ability, without assuming some responsibility for their future? Is it to the interest of society, of human progress, of education itself, that any corporation should divest itself of such responsibility? This is a question that all organizations of society must face, and the college, to say the least, can no more escape it than can the industrial organizations. The colleges have undeniably failed in the ethical leadership that might have been expected in these matters. It is impossible, however, to believe that they will not rise to the moral standard now set by the business world.

The public perhaps scarcely realizes how indifferent the colleges have been in the past to this question. The correspondence of the foundation during the last five years throws an interesting light on this whole matter, and brings out in the sharpest relief the fact that the very idea that the college has a moral obligation to its worn-out professors has not yet presented itself to most college officers and trustees as one of the things with which they are to reckon.

Communications like the following are typical. The president of a board of trustees writes that Professor A., having served the college faithfully for twenty years and having broken down absolutely in health, is compelled to stop work altogether. He is without means and has a family. It is plain that he is not eligible, under the rules, to a pension from the Carnegie Foundation, but, writes the president of the board, will not the foundation waive its rules in this case in view of the high service and pathetic situation of the teacher and care for this excellent man? For, he adds, "Of course the college can do nothing." And yet this college had an income that is generous when compared with those of most colleges. It had spent a large sum on an athletic field the previous year, and it was spending at that time more money on advertising than would be necessary to pay such a pension several times over, and this in spite of the fact that it had more students than it could care for decently. The

college trustee needs to get a clearer perspective as to his obligations and those of his college.

An institution of large income and high standing applied to the Carnegie Foundation for the retirement of a dean, a man seventy years old, who had rendered to his institution a long and distinguished service, and who stood high in the affections of the old students. The retiring allowance was voted, in view of the long service and scholarly character of this man, and it only became known months later that the trustees had arranged, in case the pension were not granted, to dismiss this faithful servant on the ground of advanced age.

The reason for this lack on the part of college trustees of that sense of responsibility for the old servant which is so striking a feature of modern civilization does not lie in any extraordinary callousness on the part of college trustees. It arises simply out of the conditions of our American colleges as related to our educational problems. The college trustee has been so trained that he looks upon any such expenditure as wholly outside of those purposes for which the college can spend its money. Not infrequently a trustee puts his hand into his own pocket to relieve (at least temporarily) the situation of a broken-down teacher, when his conscience would not allow him to spend a cent of the college money for such a purpose. Exactly the same thing happens in churches. An old and worn-out pastor is turned out to spend the remnant of his days in abject poverty —helped out now and then by casual gifts or meagre pensions, while the officers of the congregation would feel hurt at any suggestion that they had acted ungenerously. Yet it seldom occurs to them that the affectionate support of an old and faithful servant through his declining years would probably be the most christian act that the congregation could perform. This whole matter has not yet been brought within the perspective of college trustees. The time has come when this must be done. It is probably true that only a few colleges are in a position to maintain a satisfactory and generous pension system for all their teachers, but no college that is prepared to educate youth with fair efficiency is exempt from the obligation to make modest provision for those who have served it long and faithfully and who have come to the limit of their working capacity. This is simply one of the ordinary obligations of human society which all corporations in a civilized christian community must acknowledge. It is worth more to the education of young men to provide a decent support for an old teacher than to build athletic fields or even to add a new dormitory. On the other hand, a broken but deserving teacher, turned out to shift for his remaining years as best he may, is a spectacle which does more harm to the cause of education than can be atoned for by large classes of undergraduates, or a graduate school conducted at the expense of the legitimate work of the college. In a word, the obligation to care for the old servant is one of the fundamental obligations of human society, and the college can not evade it without incurring the sort of penalty which follows the evasion of all obligations. According to its ability, every college, however modest, must meet this obligation. The board of trustees that turns out an aged and faithful teacher with the phrase, "Of course the college can do nothing," simply does not appreciate that such an act is a blow at the integrity of the educational cause that they are supposed to serve, and that it is better for the college itself to make its economies elsewhere than in the evasion of the old-fashioned christian obligation to care for those who have borne the burden and heat

of the long day. The appreciation of this fact on the part of the great number of college trustees has hardly begun. It will be a matter of slow education, but it will come, and in just such proportion as standards of honesty, of sincerity and of human brotherhood improve in the colleges themselves.

And it is fairly safe to say, from past experience, that progress in these moral standards will follow close upon progress in scholarly standards. Educational righteousness will not be divorced from other forms of right living. The college which holds up sincere and fair scholarly standards will in the long run be the college that will bring to its service trustees who can face intelligently all their obligations, whether they be to the college as a whole or to the individual student or teacher.

In the present status of higher education in America there are many conditions that make it easy for college trustees to disregard the obligation to the individual in the face of numerous demands in other directions. In almost every state of the union there are more colleges in name than the country needs or can afford. They have been started without much regard to the ultimate educational demands. Many of them have existed by doing the work of high schools, and now that the high school system of most states is being rapidly developed, many of these institutions, founded in an educational enthusiasm and having neither the means nor the facilities for doing college work, have a hard struggle for existence. Denominational, state and local rivalries have done much to swell this list of weak and often superfluous colleges. In many cases their existence makes impossible that of good high schools which would far better serve the educational interests of the community.

For example, in Nebraska, which had a population in 1910 of 1,192,214, there are thirteen colleges and universities, all in the fertile and populous southeastern quarter. One of these thirteen institutions is the well-supported and accessibly located state university, another is a university conducted by the Jesuit Fathers, and a third is a privately endowed institution. Each of the remaining ten colleges was founded by a protestant denomination, is controlled by it, and appeals to the denominational constituency for support. One of these colleges gives in its catalogue no means of estimating the number of its college students. The other nine have a total college enrollment of 841, or an average of 93 college students each. The total enrollment of all of the departments of these institutions, apart from summer schools, is 3,051, or an average of 340 each. It thus appears that these colleges, founded in days of pioneer enthusiasm or of boom prospects, and maintained by efforts of denominations and the sacrifices of individuals, are chiefly engaged in preparatory, music and business school work, rather than in college education. To reduce these ten struggling colleges to two or three would relieve many conscientious people from severe financial pressure, and would greatly improve the level of higher education in Nebraska.

Similarly, in Pennsylvania, there were, at last reports, fifty-one institutions calling themselves universities or colleges. A baker's dozen of these are wholly secondary schools, in no way entitled to the name of college. Three universities in Pennsylvania can perhaps make that title good. There is one state college. There are also six worthy non-sectarian colleges. The remaining twenty-eight institutions are denominational schools and colleges—six of the Roman Catholic church, five of the Lutheran and five of the Presbyterian denominations. Three other denominations

have two colleges each and six others have one each. At least half of these denominational institutions are small, struggling and of low educational standards. One of the Presbyterian "colleges," for instance, is made up of 164 preparatory and 44 college students. One of the Lutheran "universities" is composed of 35 preparatory, 48 collegiate, 12 professional and 17 *graduate* students, 15 of the latter being non-resident. Assuming that the denominations can make real contributions to higher education, such multiplication as this is surely unjustifiable. Its effect is to reduce all education to a lower level and to depress all betterment of the teacher's place.

When an institution calling itself a college hires its professors by the month, and pays such salaries as only youths just out of college can accept, it is not to be expected that a high sense of obligation will characterize its trustees. In the gradual process of the country's growth such institutions will either disappear or find their true place, many of them as secondary schools. But, meanwhile, it is not in these institutions that one must expect a just sense of appreciation of a professor's service. It is in the stronger colleges, whether small or large, that one must expect the beginning of the movement for a just recognition of the obligation that the college owes to an old and faithful servant.

Quite naturally, the creation of the Carnegie Foundation conveyed to many college boards the impression that the establishment of such an agency lifted at once from the shoulders of college authorities all obligation to care for their worn-out or disabled teachers. The very opposite is the fact. The creation of the Carnegie Foundation makes clear and emphasizes the obligation of educational organizations to deal justly, thoughtfully and generously with those who have given a life's service to education. The very purpose of the fund is to arouse in college authorities an appreciation of this obligation. The trustees of the foundation can provide retiring allowances for only a small fraction of the college teachers of America. The duty of the individual college in this matter still remains, and is but the greater now that the principle has been made clear.

GENERAL EXAMINATIONS IN A MEDICAL SCHOOL: PLAN OF EXAMINATION RECENTLY ADOPTED AT HARVARD[1]

THE curriculum of the medical school has been a frequent topic of discussion in recent years. This association has devoted much attention to it and it continues in one form or another to occupy much of our time. A minimum curriculum requirement for a standard medical school is the basis for admission of a medical college to the Association of American Medical Colleges, and we determine the ability of the school to give efficient instruction within the limitations of this curriculum before we accept them for membership. It is clearly understood that we have fixed a minimal standard, but make no attempt to mould each school after a single fixed model. It is recognized that variations in personnel, in physical equipment and in local conditions make impossible the same type of teaching in every school. Were this possible, it would not be desirable, for no surer means of stopping progress could be conceived. It is the duty of each of us to try new methods and to share with others the experience so gained. From this alone can improvement come.

It has seemed to us at Harvard that medical schools have tended toward too great a rigidity of curriculum with too many separate examinations. This has resulted in leaving too little to the initiative of the student and in producing students too crammed with facts, too little able to think and to apply intelli-

[1] Read at the meeting of the Association of American Medical Colleges held in Chicago, February 28, 1912.

gently their knowledge. For some years we have been attempting to change this condition, and various steps toward this end have been taken. The plan of fourth-year electives on which I reported to you at a previous meeting in connection with the concentration system of teaching[2] was a step in this direction. This year we took another step in adopting a new plan of examination, which we believe will serve a twofold purpose, lessening the rigidity of the curriculum, and facilitating the correlation between the different subjects of the curriculum by placing before the student a new form of test for which he must seek to prepare himself.

The new plan of examination goes into effect with the class entering next year, and will not be applied to the classes in advance of that. Consequently four years will elapse before it has been tested in its entirety on one class. To at least five classes it should be applied before any opinion as to its real value can be given. At this time I can only explain the plan as we propose to try it. It may be of interest for you to know of it; perhaps some will care to apply it in their school. We believe it to be a distinct improvement and one that will lead to other changes in the curriculum. Already with this in view a committee has been appointed to restudy the curriculum and to propose any changes needed to meet these new conditions. The new plan of examination is to be regarded as part of a larger plan being worked out gradually and intended to improve our medical instruction.

The new plan of examinations is as follows. Written tests at the end of each course were formerly held. These are done away with, and in their place practical examinations are to be held, which are the only examinations conducted by the individual departments. The general committee in charge of examinations has supervision over the practical examinations, and they are to be a measure of the student's practical knowledge and skill. The student may choose whether he will take the practical examinations at the end of each course, or near the time of the general examination. Practical examinations in all courses included in a general examination must be satisfactorily completed before the student will be admitted to the general examination. The practical examinations are to be graded and the marks so received are to make up 40 per cent. of the grade given on a general examination.

There will be two general examinations, one at the end of the second, the other at the end of the fourth year. Both will be partly written, partly oral. The subjects comprised in the first will be anatomy, histology and embryology, physiology, biological chemistry, pathology and bacteriology. Furthermore, this examination shall assume and require an elementary knowledge of physics, inorganic and organic chemistry and biology. The subjects comprised in the second general examination will be preventive medicine and hygiene, materia medica and therapeutics, medicine, surgery, pediatrics, obstetrics, gynecology, dermatology, syphilis, neurology, psychiatry, ophthalmology, otology and laryngology. For the first general examination the student may choose either June or September, for the second, either June or January. This difference in time is due to the custom at Harvard of awarding degrees both at mid-year and at Commencement. No student who fails to pass a general examination may repeat it within the calendar year in which he failed. No student will be permitted to begin the work of the third year until the first general examination has been passed. Consequently there will be no men carrying on work conditioned in previous courses.

The written part of each general examination will consist of questions selected and arranged by the committee on examinations from lists of questions submitted by the departments concerned. The written test will be divided into two or more periods of three hours each, but there will not be separate examinations on the various courses. The answers to the questions will be graded under the direction of the committee on examinations, not under the direction of a depart-

[2] *Bulletin of American Academy of Medicine*, Vol. XI., No. 6, December, 1910.

ment. Thus in large measure the student is examined not by the man who gave the course. A single question may involve knowledge acquired in the work of several departments, and all questions are to be answered from this broader viewpoint and not from the viewpoint of any particular course. The grade so given on the written part of a general examination will make up 40 per cent. of the final mark for the general examination.

The oral part of each general examination will be conducted by boards of five members appointed by the committee on examinations, on each of which for the first general examination there must be at least one representative of the clinical branches, and for the second general examination at least one representative of the laboratory subjects. The board will determine by conference and vote the grade of the student, and the grade given on the oral part of a general examination will make up 20 per cent. of the final mark of the general examination.

This, then, is the plan for examination which we have voted to adopt. It is, as you see, a very considerable departure from the type of examination generally in vogue in medical schools. Practical examinations are given at present in most of the medical courses at Harvard. These will continue to be given. The present large number of written examinations will be reduced to two, to which are added two oral examinations, both planned to determine the student's comprehension, judgment and power rather than his detailed information. I will not occupy your time with any more minute description of the plan, and I will not enlarge upon what I consider to be its very great merits. We believe it to be a great improvement on our present system, but I will not engage in prophecy as to what it will accomplish; some years hence it can be reported again, and the reporter then will give you a criticism of its practical application with a statement of what modifications actual practise has required in it.

Henry A. Christian

Boston

DR. A. R. WALLACE AND THE UNIVERSITY OF COLORADO

In the general biology class at the University of Colorado it is customary to give a good deal of attention to the theory of evolution, and to the history of biological science. The class (about 135 students) of this year became much interested in the character and work of Dr. Alfred Russel Wallace, and took the liberty of sending him the following greeting on the occasion of his eighty-ninth birthday:

> We, the students in the general biology class at the University of Colorado, ardent admirers of your work on evolution, send you respectful greetings on the occasion of your eighty-ninth birthday, wishing you health and happiness.

To this, Dr. Wallace replied in a letter dated January 12, 1912:

> *My dear Young Friends:*
>
> Thank you much for your very kind greetings. I am much pleased that so many of you are readers of my books. The wonders of nature have been the delight and solace of my life. From the day when I first saw a bee-orchis (*Ophrys apifera*) in ignorant astonishment, to my first view of the grand forests of the Amazon; thence to the Malay Archipelago, where every fresh island with its marvellous novelties and beauties was an additional delight—nature has afforded me an ever-increasing rapture, and the attempt to solve some of her myriad problems an ever-growing sense of mystery and awe. And now, in my wild garden and greenhouse, the endless diversities of plant life renew my enjoyments; and the ever-changing pageants of the seasons impress me more than ever in my earlier days.
>
> I sincerely wish you all some of the delight in the mere contemplation of nature's mysteries and beauties which I have enjoyed, and still enjoy.
>
> Yours very truly,
>
> Alfred R. Wallace

HENRY WILSON SPANGLER[1]

In recording the death, on March 17th, of their friend and associate, Henry Wilson Spangler, Whitney Professor of Dynamical Engineering, the members of the University Faculties feel moved to give expression, how-

[1] Minute adopted by the faculties of the University of Pennsylvania.

ever inadequately, to the great loss that has come to the university in the departure of one of her most efficient and devoted servants, and to their profound sense of personal bereavement in the death of a staunch friend and wise counsellor.

With the exception of a three-year period of service in the United States Navy, Professor Spangler has been a member of the faculty of the university since 1881. For more than a quarter of a century he has labored for the advancement of the important interests committed to his trust, with a singleness of purpose and a self-sacrificing devotion that served as an inspiration to his associates, from the humblest to the highest. Endowed with quick initiative, resourcefulness, courage and self-reliance, his qualities of leadership stood out at their best at times of emergencies, such as the destruction by fire of the old Mechanical Engineering Building, and the almost immediate and orderly resumption of activities in an incomplete, new building, with such facilities as could be quickly improvised. A strict and almost military disciplinarian, he was no less rigid in the standards which he applied to himself. The respect and admiration in which he was held by his students ripened into affection as they came to see him at closer range, and recognized the bigness of heart and the warmth of friendship that lay, poorly concealed, by a certain mantle of austerity. There were few graduates who failed to turn to him at some time for helpful counsel in the perplexities of later years, or who had failed to accept it, even though it ran counter to their own promptings. They had implicit confidence in his judgment, and knew that his advice sprang from genuine, almost paternal solicitude for their welfare, and that it was never given lightly. For some years before his death, he published, at his own expense, and sent monthly to every graduate of his department, a little pamphlet called the *Connecting Rod,* designed to give them information about the department and about each other, in a simple, unaffected way. Everything he did, for that matter, was done in a like manner, for none had a more wholesome contempt for the vanities, affectations or shallow pretenses of man.

He possessed to a remarkable degree the faculty of perceiving clearly, and almost intuitively, the essential elements of a seemingly difficult problem or complex situation, and he was as quick in action as in perception. Few excelled him in the clear discernment of the fallacies of an argument or in the directness of the challenge of such fallacies. Of a thoroughly progressive bent, he did not allow himself to be carried away by the educational fads and follies of the hour. The business of education was, to him, a serious business, with which liberties were not to be lightly taken. Although his talents were frequently brought into requisition in outer circles, his duties as a teacher were, to him, ever of paramount importance, on which he allowed no professional obligations of a busy lifetime to trench unduly.

His university friends find it hard, indeed, to realize that his commanding figure has been seen upon the campus for the last time, and that in their councils his voice is stilled forever. None know better than they the sterling worth, the far-reaching significance of his performances in the service of the university, and especially of the department for which he had planned and labored so indefatigably, with such wholehearted devotion, and on which he has left the enduring impress of his rare powers.

THOMAS HARRISON MONTGOMERY[1]

The University of Pennsylvania has suffered an irreparable loss in the death of Dr. Thomas Harrison Montgomery, Jr., Professor of Zoology, who has done so much to illumine his favorite science, and who has endeared himself to his colleagues, both in this and other universities, at home and abroad.

Professor Montgomery was a son of the late Thomas Harrison Montgomery, for many years president of the American Fire Insurance Company of Philadelphia, who was a descendant of the Montgomerys of Eglinton, an

[1] Minute adopted by the faculties of the University of Pennsylvania.

ancient Norman family long settled in Scotland. He was also a great, great grandson of William White, D.D., LL.D., a graduate and trustee of the University of Pennsylvania, and first Bishop of the Protestant Episcopal Diocese of Pennsylvania. Professor Montgomery's mother, Anna Morton, was the daughter of Samuel George Morton, one of the founders of the science of craniology, and president of the Academy of Natural Sciences of Philadelphia, which is but this week celebrating its centenary.

Professor Montgomery was born in New York, March 5, 1873, and early manifested traits worthy of his ancestors. After two years as a student in the University of Pennsylvania, 1889 to 1891, he resolved to continue his studies in the University of Berlin, and secured his family's consent to the plan. His indefatigable industry immediately attracted the attention of his fellow-students, one of whom has related his astonishment at seeing a boy of eighteen working with unflagging zeal eighteen hours a day, with almost no rest or recreation, in the simultaneous acquisition of a difficult language and a group of the natural sciences. He received his degree of Ph.D. from the University of Berlin in 1894, and shortly after his return to America, was assigned by the University of Pennsylvania, a room for research work in the Wistar Institute, being the first person so appointed. During the next four years he labored with the same never failing energy, issuing a series of brilliant monographs upon some of the most difficult problems of zoology. In 1898 he was appointed assistant professor of zoology in the University of Pennsylvania. In 1903 he was called to the University of Texas as professor of zoology, but in 1908 he was recalled to take charge of the department of zoology in the University of Pennsylvania. Shortly afterward he was intrusted by the university with the chief responsibility for the planning and construction of the new Zoological Laboratory. Into this labor he threw himself with his usual untiring energy, giving personal attention to every detail. This building was completed and dedicated in 1911, and will stand as a monument to his foresight and his executive ability.

The results of Professor Montgomery's research in the technically difficult problems of cellular structure and its relation to the phenomena of heredity and the determination of sex; in the activities, habits and development of spiders and birds; in the structure and development of various rotifers and insects and in the analysis of racial descent and of evolution, have been embodied in more than eighty published monographs. He has also published a volume, "Analysis of Racial Descent in Animals," 1906, and has left in manuscript a nearly completed work on cytology.

Professor Montgomery married, in 1901, Priscilla Braislin, daughter of John and Elizabeth Braislin, of Crosswicks, New Jersey. He is survived by his widow and three sons. Professor Montgomery was essentially a scholar and teacher, and for the greater part of his short life, his energies and interests were largely absorbed in his professional work, but he was much more; he was a man of the most sterling integrity, carrying into all the relations of life the sincerity, candor and faithfulness to truth which made him great in the realm of science. Those of his colleagues on the faculty, who came only professionally into contact with him, will, perhaps, remember these traits most vividly; but those of his friends who were privileged to know something of his home life, of his wholesouled devotion as husband, father and friend, will carry with them memories not less vivid and even more true of a noble and lovable man whose loss they will not cease to mourn.

We, his fellow-professors in the University of Pennsylvania, extend, therefore, to Mrs. Montgomery and the other members of his family, our sincere sympathy in their bereavement, and direct the secretary to transmit these resolutions to the public press and the scientific journals in testimony of Professor Montgomery's distinguished services to science, education and the University of Pennsylvania, and as an expression of the esteem

and regard in which he is held by all his friends and associates.

SCIENTIFIC NOTES AND NEWS

Professor Ralph Stockman Tarr, head of the department of physical geography at Cornell University, known for his important contributions to geology and geography, died on March 21, aged forty-eight years.

The resignation of Charles Loring Jackson, Erving professor of chemistry at Harvard University, has been accepted to take effect on September 1. Professor Jackson has been on the teaching staff of the university for forty-four years.

Dr. Henry S. Carhart, late professor of physics in the University of Michigan, now retired on a Carnegie grant, has become connected with Throop Polytechnic Institute, in Pasadena, where he has taken up his home. He will have a special laboratory equipped with apparatus for his researches in the institute.

Professor John F. Hayford, dean of the college of engineering of Northwestern University, has been appointed a research associate by the Carnegie Institution of Washington and has received a grant of $6,000 in aid of his investigation of the laws of evaporation and steam flow.

M. Bigourdan, of the National Observatory, Paris, has been elected president of the Paris Bureau des Longitudes for the present year. M. Baillaud becomes vice-president and M. Andoyer, secretary.

The Entomological Society of America has named Professor J. H. Comstock, Cornell University; Dr. Henry Skinner, Academy of Natural Sciences, Philadelphia; Dr. P. P. Calvert, University of Pennsylvania; Professor Herbert Osborn, Ohio State University; Professor Vernon L. Kellogg, Leland Stanford Jr. University, and Dr. W. J. Holland, director of the Carnegie Museum of Pittsburgh, as delegates to represent the society at the Second International Congress of Entomology, to be held at Oxford, England, from August 5 to 10, 1912.

Professor William H. Hobbs, professor of geology, has been appointed by President Hutchins to represent the University of Michigan at the two hundred and fiftieth anniversary of the Royal Society of London, which will be held from July 16 to 18. Professor Hobbs has leave of absence for the coming year.

M. Lippmann, president of the Paris Academy of Sciences, will represent the academy at the celebration of the two hundred and fiftieth anniversary of the granting of the second charter to the Royal Society, which will be celebrated in July.

Vice-president T. J. Burrill and Professor S. A. Forbes, of the University of Illinois, have been in the east attending the anniversary celebration of the Philadelphia Academy of Natural Science.

Dr. Adolf Meyer, professor of psychiatry in the Johns Hopkins Medical School, sailed on March 16 for Switzerland.

Frederick H. Blodgett, Ph.D. (Hopkins '10), acting professor of biology and geology, has resigned from Roanoke College and assumed the duties of plant pathologist and physiologist at the Texas Experiment Station, College Station, Texas, on February 1. The work interrupted by the sudden death of Dr. Raymond H. Pond last summer will be resumed and some additional attention paid to plant diseases.

Professor Ellsworth Huntington, of Yale University, delivered three illustrated lectures on the "Desert," at the University of Michigan, beginning on Wednesday afternoon, February 28. In his first lecture he discussed Chinese Turkestan; Thursday, Palestine, and on Friday, March 1, "Historic Changes of the Climate in Relation to Geographical Effects."

On March 1, Dr. C. F. Hodge, professor of biology in Clark College, lectured before a convocation of the students and faculty of Indiana University, on "Civic Biology." In the evening Professor Hodge addressed the members of Sigma Xi and invited guests on the teaching of biology.

THE Philadelphia section of the American Chemical Society held a meeting at the John Harrison Laboratory of Chemistry, the University of Pennsylvania, on March 22, when Dr. L. H. Baekeland, research chemist of New York City, delivered an illustrated address on "The Theory and Technicology of Baekelite."

THE Chemical Club of the University of Illinois is giving a series of lectures on "The Field of Chemistry," endeavoring to help the younger student in chemistry to "find himself" and to show him the economic or "dollar and cents" situation. Professor A. V. Bleininger, Professor Edward Bartow, S. W. Parr and H. S. Grindley will speak on the divisions in which they are interested.

THE twelfth lecture of the Harvey Society series was delivered by Dr. W. S. Thayer, of the Johns Hopkins University, on March 23, at the New York Academy of Medicine, the subject being "Malaria."

A COMMITTEE has been formed to erect a monument in honor of the late Dr. Janssen, the eminent French astrophysicist.

A BUST of Henri de Lacaze-Duthiers, the distinguished founder of the Zoological Station at Roscoff in Brittany, is to be erected upon one of the public squares at Roscoff, near the laboratory and fronting the sea. The execution of the bust, which is to be mounted on a shaft of granite, is to be entrusted to a Breton artist, M. Guillioic. Professor Yves Delage, 16 Rue du Docteur Berger, à Sceaux (Seine), acts as secretary of the committee in charge of the proposed monument.

EDWIN SABINE RENWICK, a well-known consulting engineer, son of James Renwick, professor of chemistry and natural philosophy at Columbia University, has died at the age of eighty-nine years.

THE International Association of Medical Museums will meet at the University of Pennsylvania, Philadelphia, on April 4, and the American Association of Pathologists and Bacteriologists at the same place on April 5 and 6.

THE Washington Academy of Sciences held a conversazione, with an exhibit of new and interesting apparatus from the U. S. government and other scientific laboratories of Washington, in one of the rooms of the new National Museum on March 28.

PROFESSOR GEORGE D. HUBBARD, head of the department of geology in Oberlin College, has concluded plans for a field expedition for advanced students in connection with the work of the Oberlin Summer School. The party will leave at the close of the college year for West Virginia where New River cuts through the Appalachian Mountains, entering a territory containing examples of an unusually large number of geologic phenomena. Students furnish their own tents and equipment and camp during the entire trip, remaining in the field seven weeks and two days. This year for the first time women students will be admitted to the course. Mrs. Hubbard will accompany the expedition. Dr. Lynds Jones, associate professor of animal ecology, will conduct a field ornithological expedition to Point Pelee on Lake Erie, where special investigations will be made regarding bird migration.

THE twenty-third annual session of the Biological Laboratory of the Brooklyn Institute of Arts and Sciences will be held at Cold Spring Harbor, Long Island, New York, during the summer of 1912. Regular class work begins June 26 and continues for six weeks. Courses are offered in field zoology by Drs. Walter, Davenport and Kornhauser; in bird study by Mrs. Walter and others; in comparative anatomy in charge of Professor H. S. Pratt, Haverford College; cryptogamic botany in charge of Professor H. H. York, of Brown University; training course for field workers in eugenics in charge of Mr. H. H. Laughlin, of the Eugenics Record Office with lectures by Dr. C. B. Davenport. Facilities are offered for investigators. Further details are given in the announcement of the laboratory which may be obtained by addressing the director, Cold Spring Harbor, Long Island, N. Y.

ACCORDING to astronomical bulletins sent by Professor Edward C. Pickering, director of the Harvard College Observatory, the history

of the new star, Nova Geminorum, No. 2, is given below. Results obtained at Harvard are indicated by the letter (H). Sunday, March 10, Nova not visible on a plate showing stars of magnitude 11.5 (H). Monday, March 11, Nova well seen, magn. 5 (H). Tuesday, March 12, Nova discovered by Enebo, at Dombaas, Norway. Magn. 4. Wednesday, March 13, cablegram received at Harvard and distributed throughout America. In evening, Yerkes and (H) find spectrum of class F 5, unlike other novæ. Hydrogen lines strong and dark. University of Michigan finds hydrogen lines bright and recession 5 km. from dark lines. Magn. 3.8 (H). Thursday, March 14, Yerkes and (H) find marked change in spectrum, hydrogen lines bright on edge of great wave length, like other novæ. Magn. 3.5 (H). Friday, March 15, photograph through thick clouds show nova faint magn. 5. Hydrogen lines very bright (H). Saturday, March 16, magn. 6, spectrum like normal nova spectrum. Nebulæ lines first seen. A star magnitude 14 in place of Nova on several early plates. A letter received at this observatory from Professor Frost states that a photograph of Enebo's Nova, taken on the evening of March 15, shows that "The bright lines of hydrogen are very broad and there are many other bright bands and dark lines throughout the spectrum. The bright H and K, at about their normal positions, are strong and broad and are crossed by very sharp, dark lines. The helium lines λ 4923 and λ 5016 are strong, both bright and dark. Helium λ 4472 is not conspicuous, but probably present." The following telegram, dated March 19, has been received from Dr. W. F. King, of the Ottawa Observatory: "Spectrum Nova Geminorum by Plaskett March eighteen seven tenths, numerous bright bands, maxima to red, and several narrow absorption lines, calcium, magnesium, iron. Velocity of recession about seventeen kilometers, magnitude about five and a half."

Among the changes recommended at the University of Chicago in the recent report of President Judson, is a readjustment of the time element in precollegiate courses by the School of Education, a tentative scheme being as follows: "From the age of six to twelve, the elementary school; twelve to fifteen, the secondary school; fifteen to eighteen, the college (a junior college); the years following eighteen, the university. From the university at the age of twenty the student might take the baccalaureate degree, at twenty-one the master's degree, at twenty-two or three the various doctors' degrees. At the age of twenty-five or six if he enters on professional life he should be engaged in its practise, and by the time he is thirty he should be well established. In like manner at the age of twenty, if a student desires to enter on business he should be ready to do so, or if on the whole he prefers to enter business immediately from the three years of the college instead of entering the university at all he could do that with good training at the age of eighteen."

The two federal bureaus engaged in the search for potash—the Bureau of Soils of the Department of Agriculture and the Geological Survey of the Department of the Interior—are in receipt of promising telegraphic news from their field representatives. A potash deposit of apparently great importance has been discovered at Borax or Searles Lake in the northwestern corner of San Bernardino County, California. This lake or playa is the last remaining pocket of a once much greater lake which has almost dried up and its central depression contains a large body of crystalline salts known to consist of common salt and sulphate and carbonate of soda with smaller quantities of borax. This salt body is saturated with brine, and interested persons stimulated by the governmental search for potash recently secured an analysis of old sample material from this brine. The result being significant, the lake was visited jointly by representatives of the Geological Survey and of the Bureau of Soils who took brine samples from six wells distributed over the salt flat. Analyses of these samples have been made by the cooperative laboratory at the Mackay School of Mines, at Reno, Nevada, and show an average of 6.78 per cent. of potassium

oxide (K_2O) in solution. The average salinity of the brine is 43.82 grams of solids per one hundred cubic centimeters. Comparison of the results indicates that the brines are nearly uniform throughout the flat. The probable importance of the deposits is due to the occurrence of the potassium salts in soluble form in a natural saturated brine, and under climatic and other conditions especially favorable to its separation and recovery by solar evaporation. Existing data give reasonable assurance that the brine-saturated salt body is at least 60 feet thick and covers an area of at least eleven square miles. Assuming the salt body to contain twenty-five per cent. by volume of the brine, the total amount of potassium oxide is estimated at over four million short tons. This estimate is believed to be very conservative, and the available tonnage may well be expected to exceed ten million tons, which would supply the country, at the present rate of consumption of potash, for thirty years. At any rate it appears that this locality constitutes a very important source of potash in probably readily available commercial form.

As a result of the recommendations recently made by a joint committee of the South African Association for the Advancement of Science and the Royal Society of South Africa, a general committee, says *Nature* quoting from *The South African Journal of Science*, has been constituted for the purpose of considering applications received for grants. Five grants, amounting in all to £250, were made at the first meeting of the committee held towards the end of last year. The grants were: (1) £40 to Professor W. A. D. Rudge, of Grey University College, Bloemfontein, to obtain a continuous record of the variations in the atmospheric gradient at various places, and to ascertain the relation between potential gradient and altitude, and between the diurnal variation of the gradient and the variation in the atmospheric pressure; (2) £45 to Professor A. Young, of the South African College, Cape Town, to investigate the occurrence of semi-diurnal, diurnal and spring and neap tides observed in connection with an artesian well in the Cradock district; (3) £75 to Miss D. F. Bleek, to proceed to the Kalahari, so as to obtain phonographic records of the spoken language of the Bushman tribes north of the Orange and Vaal rivers; (4) £50 to Mr. R. N. Hall, to visit localities in Rhodesia, where Bushman paintings exist; (5) £40 to Mr. W. T. Saxton, of the South African College, Cape Town, for the purpose of studying the fungus diseases of trees in the Transkeian forests, investigating the ecology of the typical formations of the Transkeian territory, investigating a reported occurrence of the typical western province flora at St. John's, and to collect material for the study of the two genera of South African cycads, *Stangeria* and *Encephalartos*.

DR. G. D. THOMSON, of Canton, writes the *Geographical Journal* an account of some caves in the south of the Kwang-tung province, which, he says, have never yet been described by a European traveler. They lie about 250 miles southwest of Canton, by the route followed by boat. This involves the descent of the Canton River to the sea, and a coasting voyage west to the mouth of the Yeung-Kong River, which is ascended to the city of the same name. Here it is necessary to change boats, taking a native craft, pulled or poled by native men and women when the wind is contrary. In this way the walled city of Yeung-chou is reached, and the caves are situated a mile or more to the west of it. The chief cave is of large size and very beautiful. The hills in the immediate neighborhood rise abruptly from the plain in jagged rocky cliffs of totally different formation from the surrounding hills and mountains. At the entrance and on ledges high up the cliff there is a Buddhist monastery and shrines, presenting a gaudy appearance. From the outer chamber, which is beautified with stalactites and stalagmites, a flight of steps leads up to a second, cathedral-like cavern, not visible from the first. In this there is a stone table and stools, and shrines around the walls in niches, but the whole upper part is untouched by

man. At the far end a passage lets in the daylight from the opposite side of the hill. Dr. Thomson proposes to call this group of limestone caves by the name of Lord Kinnaird, in gratitude for the kindness shown to him and his brother during their college days. He refers also to various other groups of caves in the same province, which make of this part of China a veritable cave country. Though they have been described by Dr. Henry in his book called "Ling Nam," they are far from being generally known. They include the "Cathedral cave" (so named by Dr. Noyes, of Canton) and others to the north of that city on the Lien-chow and North rivers; and those in the neighborhood of Shiu-hing on the north bank of the main Si-kiang or West River.

In connection with the graduate course in Highway Engineering at Columbia University, the following illustrated lectures have been given during the month of March by non-resident lecturers in highway engineering at 8:30 P.M.

March 4—"Sand-clay Roads and Oil-cement-concrete Pavements," Logan W. Page, director, United States Office of Public Roads, Washington.

March 8—"Mixing Plants for Bituminous Pavements," Francis P. Smith, chemical and consulting paving engineer, New York City.

March 11—"Comparison of Pavements," George W. Tillson, consulting engineer to the president of the Borough of Brooklyn, New York City.

March 15—"The Construction and Maintenance of Park Roads," John R. Rablin, Massachusetts Metropolitan Park Commission, Boston.

March 25—"The Organization of the State Highway Department of New York," John A. Bensel, New York State Engineer, Albany.

March 27—"Asphaltic Crude Oils and their Use in Highway Construction," Dr. Albert Sommer, Consulting Chemist, Philadelphia; or

"The Construction and Maintenance of European Roads," Arthur H. Blanchard, professor of highway engineering, Columbia University.

Seventy departments of the University of Wisconsin will be represented in the first exposition held at a university, which will take place at that institution on April 19 and 20. Dr. Hermon C. Bumpus, business manager of the university, formerly director of the American Museum of Natural History, and Professors Stephen W. Gilman, of the course in commerce, C. K. Leith, of the geology department, and K. L. Hatch, of the college of agriculture, will comprise the faculty committee that will cooperate with 300 senior students in preparing for this exhibition. The engineering school will be represented by over 50 mechanical devices shown by its various departments. Among the interesting exhibits of the college of agriculture will be a model dairy and a model barn. Regular milking time will be announced so that visitors to the exposition can see mechanical milking machines in operation. The university bacteriological department will have an exhibit showing how many germs are afloat in the air of Madison, Milwaukee and Chicago. Plates will be put on the street corners in these cities for ten minutes and then will be put on exhibition to show the vast number of germs present in city air. Germs of hydrophobia and tuberculosis will also be on exhibition to be viewed through the microscope. How disease is transferred by handshaking will be shown by having a student with a germ-laden hand shake hands with fifty clean hands and then show the resulting contamination through the microscope. The home economics department of the university will be represented in the exhibition by a booth showing how to design and fit dresses and how to distinguish between good and bad taste in house decoration and furniture selection.

UNIVERSITY AND EDUCATIONAL NEWS

The Harvard Graduate School of Applied Science has received from an anonymous donor a gift for a high-tension electrical laboratory. It will be built near the Jefferson Physical Laboratory. It is expected that the laboratory will have at its disposal an alternating current of 1,000,000 volts and a direct current of 100,000 volts.

ANNOUNCEMENT has been made of a gift of $100,000 by Mr. J. P. Morgan to the Peabody College for Teachers. The trustees of the George Peabody fund have agreed to give an additional $500,000 to the college, provided it collects $1,000,000 by September 1, 1913.

Several fellowships in industrial chemistry will be offered by the chemical department of the North Dakota Agricultural College for the coming year. These fellowships, of the value of $500, will be given for research work in connection with the paint industry.

MR. RUNCIMAN, president of the Board of Agriculture and Fisheries, has announced that in addition to the block grant of £1,300 a year given by the board to University College, Reading, in aid of agriculture and horticulture, and in addition to a further grant of £1,000 a year recently offered to the college in aid of advisory work among farmers, the Board of Agriculture would provide £2,500 a year and one half of the capital cost of a building with the object of establishing a dairying research station at the college, on condition that the grant of $2,500 a year was supplemented by £1,300 a year provided locally for the purpose.

THE degree of doctor of public health has just been established at the University of Wisconsin by vote of the regents upon recommendation of the university faculty. Candidates for this degree must hold the degree of doctor of medicine from medical schools of approved standing and must have spent at least two years in the study of sciences related to hygiene and public health subsequent to the regular medical course.

PROFESSOR GEORGE P. BURNS, who went to the University of Vermont two years ago as head of the department of botany, will not return to the University of Michigan, from which he had leave of absence.

THE Kaiser Wilhelm professor at Columbia University for the academic year 1912–13, who is nominated by the Prussian Ministry of Public Instruction, will be Phelix Krüger, Ph.D., professor of psychology at the University of Halle.

DISCUSSION AND CORRESPONDENCE

THE USE OF THE WORD "GENOTYPE"

IN a recent issue of SCIENCE, Bather[1] takes exception for the third time to the use of the word "genotype" by writers on Mendelism who apply the term in a sense quite different from that in which it was first proposed and has since been used consistently and continuously. It is obvious that Bather is not familiar with the situation here in America or surely he would be less caustic in his remarks. Certain of our biologists have been suffering from an attack of what might be called *Dementia Mendeliana.* Those of us who have escaped infection or who have recovered from the attack but who are surrounded by the sufferers are inclined to refer to their actions "less in anger than in sorrow."

Doubtless it is hard for a foreigner to understand the situation here in America. In biology no less than in politics we have "progressive" elements. And certain of these progressives have taken to themselves a name "geneticists." Also they have evolved a language. In doing this they have appropriated freely from the older language of mathematics, but not without exciting the suspicions of mathematicians. They have likewise appropriated certain terms from biological taxonomy, and since few if any of the leading "geneticists" are more familiar with taxonomy than with mathematics it is not strange that some of the borrowed terms have been misapplied.

There are few mathematicians who are familiar enough with biological matters to realize what liberties have been taken with their language, and few biologists sufficiently mathematical to be disturbed. It remains then for those biologists whose linguistic sensibilities are keen, to be annoyed if not irritated by the misapplication of biological terms in this new language.

But the present outlook is not without its hopeful features. It is to be observed that a movement toward segregation is taking place. The literature of this cult is not so widely

[1] SCIENCE, N. S., 35: 270.

scattered as formerly, though its volume remains large. During the last convocation week the American Association for the Advancement of Science was spared somewhat by the fact that most of the geneticists met in a city apart. Thus we venture the hope that in due time the segregation may become so complete that scientists may be free to peruse their favorite journals without risk of that offense to the finer sensibilities which results from seeing familiar words or characters abused.

CARL S. SCOFIELD

LANHAM, MD.,
February 18, 1912

UNIVERSITY REGISTRATION

To the Editor of Science: Information received from the registrar of the University of Nebraska after the university registration statistics printed in the issue of Science for January 5, 1912, had gone to press, increase the enrollment of that institution as of November 1, 1911, from 2,733 to 3,459, as against 3,661 on November 1, 1910. The decrease is due to the fact that the affiliation relations of the university with the conservatory of music, which had existed for a number of years, were severed during the summer of 1911. The gain in attendance on the other departments was not large enough to offset the loss in music students.

In the net total registration of 4,889 students at Cornell University (excluding the summer session) there were included 477 students in the 1911 short-course in agriculture. These students are not in attendance at the university this academic year, although approximately that number of students are enrolled in the 1912 winter course. If these students are excluded from the Cornell registration, the winter attendance would be 4,412, instead of 4,889.

As for the figures of the University of Minnesota, in connection with which an explanation was given in a footnote, the situation is as follows: It has been customary for a long time to include in the total registration of the university the registration of the *School* of agriculture, which is to be distinguished sharply from the *College* of agriculture, the latter being of collegiate grade, while the school has a three-year course of secondary grade. The students in attendance on the school, therefore, while not technically preparatory students in the sense that they are being fitted for college work, should really be classed as preparatory students—in any event they can not logically be regarded as college students. Subtracting from 4,307 students recorded as being in attendance at the university on November 1, 1911 (including the summer session), the 775 students in the school of agriculture, leaves a balance of 3,532 students of collegiate and university grade.

The figures for the Harvard School (787) included only the students in the summer courses in arts and sciences. There are, in addition, 278 students in science in the summer school of dental medicine. The total summer attendance thus becomes 1,065. Of these 115 students returned for work in the fall, the net total attendance at Harvard, inclusive of the summer session, thus being 5,674 instead of 5,426.

The University of Cincinnati submitted a table showing that its enrollment in all faculties on November 1, 1911, was 1,324 students, as against 1,416 on November 1, 1910, 1,364 on November 1, 1908, and 1,068 on November 1, 1903.

Taking account of these revisions, the net total attendance of 28 American universities as of November 1, 1911, including the summer session, but making due allowance for the summer session students who returned in the fall, is given in the following list.

1. Columbia	7,938
2. California	5,724
3. Harvard	5,674
4. Cornell	5,609
5. Michigan	5,452
6. Chicago	5,390
7. Pennsylvania	5,220
8. Wisconsin	5,015
9. Illinois	4,929
10. New York	4,055
11. Minnesota	3,773
12. Ohio State	3,567

13.	Nebraska	3,459
14.	Northwestern	3,438
15.	Syracuse	3,307
16.	Yale	3,224
17.	Missouri	2,596
18.	Texas	2,539
19.	Kansas	2,265
20.	Indiana	2,154
22.	Iowa	1,967
21.	Tulane	2,040
23.	Stanford	1,648
24.	Princeton	1,543
25.	Western Reserve	1,331
26.	Cincinnati	1,324
27.	Johns Hopkins	1,057
28.	Virginia	804

RUDOLF TOMBO, JR.

CONVOCATION WEEK MEETINGS

I HAVE read with interest two recent communications[1] in SCIENCE relative to the meeting place of the different scientific societies, with which I am heartily in accord. To me the only valid objection to holding these meetings at the time and place of the American Association is the tendency of the different meetings to conflict with one another. This difficulty should be to a great extent obviated if the executive committees of related societies (for example, zoologists, naturalists, anatomists) were to jointly arrange the program for their societies, allowing this program if necessary to include the day preceding or following those on which the general association meets. Certainly this difficulty was not obviated last year when the three societies above named met at Princeton, the meetings of zoologists and anatomists distinctly conflicting with each other. On the other hand, the great objections, as it seems to me, of holding these meetings at different places and at the same time is the entire loss of the benefits of the general association by those who wish to attend the sectional meetings. Speaking personally, I was much disappointed to miss the Sigma Xi convention at Washington last year in order to attend the zoologists' meeting at Princeton. To one living at some distance from the heart of things a trip to the annual meetings involves a considerable sacrifice of time and money, and he feels like getting the largest return possible for such sacrifice, which was not possible for all of us with the meetings arranged as they were last year.

[1] Morse, Max, SCIENCE, December 22, 1911. Reese, A. M., SCIENCE, January 12, 1912.

If the present policy of aloofness on the part of certain societies be deemed desirable in future, might it not at least be possible to arrange the sectional meetings so as not to conflict with those of the general association?

In the case of a society with eastern and central branches (viz., zoologists), where the majority of the members belong to the former branch, I believe it would be fair to all to hold two eastern meetings to each one in the central district, such meetings to be joint meetings of the two branches. Separate meetings by each branch seem to me undesirable, at least if such meetings are held at the same time, as was the case with the zoologists in 1910.

R. T. YOUNG

UNIVERSITY OF NORTH DAKOTA

THE TIDAL MACHINE

TO THE EDITOR OF SCIENCE: The undersigned desires to say that the machine described in the issue of this journal of February 23, 1912, under the name of "The Harris Tidal Machine" is the product of one of the bureaus of this government, the Coast and Geodetic Survey. The officials of that bureau, who are well acquainted with all the details of its development, from first inception to final completion, named it "The Coast and Geodetic Survey Tide Predicting Machine." Under that name it was described briefly in the *Journal* of the Washington Academy of Sciences, July 19, 1911, and more fully, with illustrations, in *Engineering News* of July 20, 1911.

E. G. FISCHER

WASHINGTON, D. C.,
February 26, 1912

REPLYING to Mr. Fischer's note concerning my article on "The Harris Tidal Machine" published in this journal on February 23,

1912, I wish to state that to the best of my knowledge and belief no "christening" of the machine has yet taken place; if it has, I am morally certain that the inventor was not invited to the ceremony. As the title "The Coast and Geodetic Survey Tide Predicting Machine" used by Mr. Fischer is not only lengthy but includes the Ferrell Machine used by the office for many years, the title under which I described it is logical in that it differentiates the Harris Machine from its predecessor, at the same time serving as a mark of honor to its inventor.

I wrote three letters to the Coast Survey Office protesting against the injustice done Dr. Harris in Mr. Fischer's article in *Engineering News* of July 20, 1911, and calling attention to the misstatements contained therein, requesting that the office publish suitable corrective notes. My letters were unanswered and I, therefore, laid the facts before the public in my article.

Samuel Tierney, Jr.

QUOTATIONS

DR. WILEY AND THE BUREAU OF CHEMISTRY

On the 9th of April, 1883, I took the oath of office and entered upon the discharge of my duties as chief of the Bureau of Chemistry, in the Department of Agriculture. For the past twenty-nine years I have endeavored to discharge these duties according to the dictates of my conscience, the knowledge at my command and the obligations of my oath. In retiring from this position after so many years of service it seems fitting that I should state briefly the causes which have led me to this step. Without going into detail respecting these causes, I desire to say that the fundamental one is that I believe I can find opportunity for better and more effective service to the work which is nearest my heart, namely, the pure food and drug propaganda, as a private citizen than I could any longer do in my late position.

In this action I do not intend in any way to reflect upon the position which has been taken by my superior officers in regard to the same problems. I accord to them the same right to act in accordance with their convictions which I claim for myself.

After a quarter of a century of constant discussion and effort, the bill regulating interstate and foreign commerce in foods and drugs was enacted into law. Almost from the very beginning of the enforcement of this act I discovered that my point of view in regard to it was fundamentally different from that of any of my superiors in office. For nearly six years there has been a growing feeling in my mind that these differences were irreconcilable, and I have been conscious of an official environment which has been essentially inhospitable.

I saw the fundamental principles of the food and drugs act, as they appeared to me, one by one paralyzed and discredited. It was the plain provision of the act and was fully understood at the time of the enactment, as stated in the law itself, that the Bureau of Chemistry was to examine all samples of suspected foods and drugs to determine whether they were adulterated or misbranded, and that if this examination disclosed such facts the matter was to be referred to the courts for decision.

Interest after interest, engaged in what the Bureau of Chemistry found to be the manufacture of misbranded or adulterated foods and drugs, made an appeal to escape appearing in court to defend their practises. Various methods were employed to secure this, many of which were successful. One by one I found that the activities pertaining to the Bureau of Chemistry were restricted and various forms of manipulated food products were withdrawn from its consideration and referred either to other bodies not contemplated by law or directly relieved from further control.

A few of the instances of this kind are well known. Among these may be mentioned the manufacture of so-called whiskey from alcohol, colors and flavors; the addition to food products of benzoic acid and its salts; of sulphurous acid and its salts; of sulphate of copper; of saccharin and of alum; the manufacture of so-called wines from pomace, chemicals and colors; the floating of oysters often in polluted waters for the purpose of making

them look fatter and larger than really they are for the purpose of sale; the selling of moldy, fermented, decomposed and misbranded grains; the offering to the people of glucose under the name of "corn syrup," thus taking a name which rightfully belongs to another product made directly from Indian corn silks.

The official toleration and validation of such practises have restricted the activities of the Bureau of Chemistry to a very narrow field. As a result of these restrictions, I have been instructed to refrain from stating in any public way my own opinion regarding the effect of these substances upon health, and this restriction has conflicted with my academic freedom of speech on matters relating directly to the public welfare.

These restrictions culminated in the summer of 1911 with false charges of misconduct made against me by colleagues in the Department of Agriculture, which, had it not been for the prompt interference on the part of the President of the United States, to whom I am profoundly grateful, would have led to my forcible separation from the public service. After the President of the United States and a committee of Congress, as a result of investigation, had completely exonerated me from any wrongdoing in this matter, I naturally expected that those who had made these false charges against me would no longer be continued in a position which would make a repetition of such action possible. The outcome, however, has not sustained my expectations in this matter. I was still left to come into daily contact with the men who secretly plotted my destruction.

I am now convinced that the freedom which belongs to every private American citizen can be used by me more fruitfully in rallying public opinion to the support of the cause of pure food and drugs than I could with the limited activity left to me in the position which I have just vacated. I propose to devote the remainder of my life, with such ability as I may have at my command and with such opportunities as may arise, to the promotion of the principles of civic righteousness and industrial integrity, which underlie the food and drugs act, in the hope that it may be administered in the interest of the people at large, instead of that of a comparatively few mere manufacturers and dealers.

This hope is heightened by my belief that a great majority of manufacturers and dealers in foods and drugs are heartily in sympathy with the views I have held and that these views are indorsed by an overwhelming majority of the press and the citizens of the country. In severing my official relations with the Secretary of Agriculture I take this opportunity of thanking him for the personal kindness and regard which he has shown me during his long connection with the department. I can not leave the Bureau of Chemistry without expressing to my assistants of all grades my appreciation of their loyalty and devotion to me.—Statement by Dr. H. W. Wiley.

SCIENTIFIC BOOKS

A Descriptive Catalogue of the Higher Groups, Genera, Species and Subspecies of Birds known to occur in North America, from the Arctic Lands to the Isthmus of Panama, the West Indies and other Islands of the Caribbean Sea, and the Galapagos Archipelago. By ROBERT RIDGWAY, Curator of the Division of Birds. Part V. [Containing] Family Pteroptrochidæ—The Tapacolas. Family Formicariidæ—The Antbirds. Family Furnariidæ—The Ovenbirds. Family Dendrocolaptidæ—The Woodhewers. Family Trochilidæ—The Humming Birds. Family Micropodidæ—The Swifts. Family Trogonidæ—The Trogons. Washington: Government Printing Office. 1911. Bulletin of the United States National Museum. No. 50. Part V. "Issued November 29, 1911." 8vo. Pp. xxiii + 859; pls. xxxiii.

Part V. of Ridgway's monumental work on the birds of north and middle America completes the first two thirds of this great undertaking, Part I. of which appeared in October, 1901. As Part IV. was issued in 1907, a longer interval than usual has elapsed between the appearance of Parts IV. and V., due in

part to interruptions by field work and illness, and in part to the preparation of matter originally intended, and even put in type for the present volume, but which it was found would too greatly increase its size. This matter, embracing the large family of Woodpeckers, will appear in Part VI., now in an advanced stage of preparation.

The present volume includes seven families, five of which are exclusively American, four of them being very numerous in species and subspecies. These are the Pteroptochidæ (with only one species in the geographical area of the present works), the Formicariidæ (66 species and subspecies), the Furnariidæ (29 species and subspecies), the Dendrocolaptidæ (41 species and subspecies) and the Trochilidæ (174 species and subspecies). The other two families included are the Micropodidæ (25 species and subspecies) and the Trogonidæ (23 species and subspecies), the first of wide distribution throughout the world, the other common to all tropical regions. The same careful treatment in respect to technical details that has characterized the previous volumes is still maintained, as are the bibliographic references, which give at a glance the history of the species and higher groups as treated by preceding authors. The "keys" include many extra-limital genera and species, thus greatly widening the scope of the work as announced on the title page. There is a tendency to recognize as genera many groups usually treated as subgenera or altogether ignored; they are as a rule natural groups and their recognition in nomenclature is consistent with the present almost universal tendency to differentiate slight geographical forms as worthy of recognition as subspecies.

As heretofore, the work is based upon the material of the United States National Museum plus that of all the principal collections, private as well as public, in this country, the specimens examined in preparing the present volume numbering 14,358, of which about 6,000 are in the joint collections of the National Museum and Biological Survey. Of the more than 8,000 borrowed specimens, nearly all were furnished by three institutions, the Museum of Natural History in New York, the Museum of Comparative Zoology at Cambridge and the Carnegie Museum of Pittsburgh. Through this system of cooperation the leading museums are benefited as well as the author, since the loaned material is returned bearing the identifications of the leading expert on the subject, and in addition the results of the author's investigations as here set forth are more comprehensive and rest on a firmer basis than would otherwise be possible. With even these resources the author has to regret that in several of the families a number of genera and very many species were not available for examination, so his "effort to bring order out of chaos can be considered as only partially successful."

While the scope of the work is restricted to the technicalities of the subject, references are made to nests and eggs "where some particular style of nest or coloration of eggs is characteristic of a group (family or genus), as a sort of accessory or supplemental group character." A paragraph is also given in the description of each family to a statement respecting the range in size, character of plumage, manner of life and nature of the food of the species, as well as their number and geographical distribution. Thus under the family Trochilidæ are some items of information not generally known even to all ornithologists, and much less to the general reader.

"Inhabitants exclusively of America, the Humming Birds constitute not only the most charming element in the wonderfully varied bird-life of the Western Hemisphere, but, also, without doubt, the most remarkable group of birds in the entire world. No other group of birds is so brilliant in plumage or so different from all others in their mode of flight and manner of feeding. The general habits of Humming Birds are not dissimilar to those of birds in general. They are both aerial and arboreal, but are unable to progress upon the ground or any flat surface by means of their legs and feet alone. They perch readily and frequently upon trees or bushes, or may even cling to rocks or other vertical surfaces; and

their nidification presents nothing that may be deemed peculiar or even specially characteristic. In their flight and manner of procuring their food, however, they differ strikingly from all other birds, in these respects closely resembling certain insects, especially the crepuscular hawkmoths (Sphingidæ). Their food, consisting mainly of small insects, but in part also of the nectar of flowers, is mostly gleaned from blossoms, before which they poise, with wings so rapidly vibrating as to be invisible except as a dim haze or halo partly surrounding the body and producing the humming sound from which these birds derive their vernacular name, the bill thrust inside the flower and the slender, semitubular tongue extended into the depths of the blossom. Some species, instead of feeding from flowers, glean their insect food from the bark of forest trees, following along the branches in suspended flight in the same manner that the others pass from flower to flower. In their feeding from flower to flower, Humming Birds, like bees, butterflies, and moths, perform the same office in the economy of nature as insects by transferring pollen from one bloom to another, and thus assisting in the fertilization of plants. In flying from one point to another, the flight of Humming Birds, while essentially direct, is usually more or less undulating, and so extremely rapid that the eye can scarcely follow. Often this flight is accompanied (at least in the case of males of some species) by a more or less remarkable screeching or grating sound, produced mechanically by some peculiarity of wing-structure.

"Diminutiveness of size and metallic brilliancy of coloring are the chief external characteristics of Humming Birds, though exceptions to both occur; and in these respects they, as a group, have no rivals. Unfortunately, stuffed specimens convey but a faint idea of their splendid coloring, for the perfection of their changeable refulgence can be fully realized only in the living bird, whose every change of position flashes to view a different hue—emerald green replacing ruby red, sapphire blue succeeding fiery orange, or either becoming opaque velvety black—according to the angle at which the sun's rays touch the feathers, an effect which can only partially be imitated with the stuffed specimen by artificially changing its position with reference to the light. Many species have a spot of the most luminous or brilliantly metallic color (usually green) that it is possible to imagine on the forehead at the base of the bill, this spot being surrounded by the most intense velvety black—evidently to enhance the brilliancy of the ornament by contrast, just as a jeweler would, for the same purpose, display a diamond or other gem against a background of black velvet. Often there is a spot of brilliant color and one of a contrasting hue just below it, the result being that first one color, then the other, is flashed forth as the bird changes slightly its position."

The thirty-one plates give the structural details of bill, wings, tail and feet of each of the 121 genera, thus greatly facilitating identification. It is hoped that Part V. may be followed in due time by the remaining volumes of this invaluable work, so indispensable to all students of American birds.

J. A. ALLEN

The Hindu-Arabic Numerals. By DAVID EUGENE SMITH and LOUIS CHARLES KARPINSKI. Boston and London, Ginn and Company. 1911. Pp. vi + 160.

This book gives in compact form a readable and carefully prepared account of the numerous researches which have been made in the endeavor to trace the origin and development of the Hindu-Arabic numerals. Teachers of mathematics will welcome it, while students specializing in the history of mathematics will derive great help from the many bibliographical references to other publications on this subject. Like the arithmetician Tonstall the authors read everything in every language and spent much time in licking what they found into shape *ad ursi exemplum,* as the bear does her cubs. But it would not be a correct statement, were we to convey the idea that the book does not embody original research. In several cases the authors have been able to correct mistakes of earlier writers

and to add results of their own research. In a few instances this history appears to us incomplete and defective. This we shall endeavor to show in what follows.

The authors very properly give much attention to the study of routes of commercial travel. There is every reason to believe that the migrations of the numerals took place along commercial routes. The authors consider the possibility of an early influence of China upon India; they speak of trade routes and the interchange of thought by land and sea, between countries bordering on the Mediterranean and far-off India. They even point out early relations of Greece with China. In view of these careful studies it is singular that practically nothing should be said on the intercourse which did or did not exist between Babylonia and India during the centuries immediately preceding and following the beginning of the Christian era. They ignored a question which lies at the root of present-day speculations on the earliest traces of the principle of local value and the symbolism for zero. Of course, local value is considered by the authors in connection with the Hindu-Arabic numerals. Not to do so would be to examine the shell and ignore the kernel. Were these fundamental notions wholly of Hindu origin or were the rudimentary ideas relating to them imported into India from neighboring territory? In the book under review this vital question is not adequately discussed. The authors are correct in stating that the preponderance of authority has been in favor of the hypothesis that our numeral system, with its concept of local value and our symbol for zero has been of Hindu origin. But this conclusion is coming to be recognized as unsafe. The change of opinion that is taking place is voiced by two German authors of brief histories, Tropfke and Günther. In 1902 Tropfke said[1]

> Dass unser Positionssystem mit seinen Ziffern indischen Ursprunges ist, steht fest.

[1] "Geschichte der Elementar-Mathematik," I., p. 10.

In 1908 Günther said[2]

> Man kann . . . sich den Vorgang vielleicht so denken, dass Indien von Babylon her die ersten schwachen Andeutungen des Stellenwertes empfing, sie in seiner Weise um- und ausbildete und später das reiche Geschenk des fertigen Positionssystemes den Nachkommen jener Geber zurückerstattete.

The evidence in favor of a possible Babylonian origin is even stronger than as stated by Günther, for he was apparently unaware that symbols for zero had been found in Babylonia. These symbols are mentioned, but not adequately discussed by Smith and Karpinski, on page 51. The facts in our possession to-day are about as follows:

1. Two early Babylonian tablets, one probably dating from 1600 or 2300 B.C., use the sexagesimal system and the all-important principle of local value. It so happens that they contain no number in which there was occasion to use a zero.

2. Babylonian records from the centuries immediately preceding the Christian era give a symbol for zero which was apparently "not used in calculation." It consisted of two angular marks, one above the other, roughly resembling two dots, hastily written.

3. About A.D. 130, Ptolemy in Alexandria used in his "Almagest," the Babylonian sexagesimal fractions and also the omicron O to represent blanks in the sexagesimal numbers. The symbol was not used as a regular zero.

4. Strabo and others have described the trade routes by land and the trade between Babylonia and India, also the trade by sea.

5. Sexagesimal fractions were used by Hindu astronomers. Historians do not deny that the Indian sexagesimal fractions were of Babylonian origin.

6. The earliest form of the Indian symbol for zero was that of a dot, which, according to Bühler, was "commonly used in inscriptions and manuscripts in order to mark a blank." This early use of the symbol resembles somewhat the still earlier use made of symbols for zero by the Babylonians and by Ptolemy. Probably Āryabhata, in the fifth century

[2] "Geschichte der Mathematik," I., p. 17.

A.D., knew our zero. The earliest undoubted occurrence of our zero in India is in 876 A.D.

Were there overflows of Babylonian science into Greece and India? The question is pertinent. The possibility of overflows into India has been recognized not only by Günther, but by Nallino, who states that the Chaldeans of 100 B.C. (and even earlier) knew the sidereal year (estimated at 365 d. 6 hr. 13 m. 43 sec.) and that this knowledge probably passed from them to the Hindus and Persians. This statement is quoted by H. Suter with apparent approval.[3] It seems to us that these facts point directly toward a summary of the case, somewhat as quoted above from Günther.

In recounting the earliest uses made of the Arabic numerals in Egypt and the Occident, reference is made to a trace on a pillar of a church in Egypt, giving the date 349 A.H. (=A.D. 961). Strange to say our authors completely ignore similar evidence, as given in the *Philosophical Transactions* of London. Why should this be? No less prominent a mathematician than John Wallis arrived at the conclusion that "their use in these parts was as old at least as . . . the middle of the eleventh century."[4] Wallis refers to the "Mantle-tree of the Parlour Chimney at the dwelling House of Mr. Will. Richards, the Rector of Helmdon in Northampton-shire," bearing an inscription with the date "A° Do^{i} M° 133" (=A.D 1133). Thomas Luffkin[5] names a building in Colchester bearing the date 1090. These dates are of interest to an Englishman or an American. If they are to be rejected, it would seem that the reasons therefor should be set forth in a publication aiming to weigh minutely all respectable evidence. Smith and Karpinski make no mention of an earlier use than 1539 of the numerals in Great Britain.

In describing the different shapes of the zero in Europe the authors overlooked the curious use of *theta* θ to represent zero, found in the writings of Michel Rolle, and Eneström's note on this notation in "L'Intermédiaire des mathématiciens," II., 1895, p. 283.

It has been said of early American geologists that they crossed the western plains, eager to reach the Rocky Mountains, there to grapple with the problems relating to the geology of our land, that in so doing they neglected the geologic problems presented by the plains themselves. In the same way our authors hastened back half a thousand years to reach the conspicuously formative periods, and in so doing they forgot to take note of matters of interest connected with recent time, which for historical research is far from barren. Our authors note the different shapes which the numerals assumed among the Hindus, Arabs and Europeans of the Renaissance. But if I mistake not, interesting forms, worthy of study, are found in seventeenth and eighteenth century manuscripts, stored away in American libraries. It is of some interest that the figure 8 sometimes had the shape of our dollar mark written with a single downward stroke, thus, $. I remember mistaking such an eight for a dollar mark and recognizing my error only when the sum given in the manuscript would not come out as represented, except on the supposition that the mark stood for 8. The authors point out anomalous combinations of the Hindu-Arabic and the Roman numeral symbols which occurred more or less accidentally in the fifteenth and sixteenth centuries, but they fail to notice a curious combination which occurs with surprising regularity in Spanish-American manuscripts during the three centuries preceding the beginning of the nineteenth century. Of this notation we shall speak in a separate article.

On page 28, line 10, the word "vertical" should be replaced by the word "horizontal." In the table of contents there is an omission such that the pronoun "their" in the line "Early ideas of their origin" refers to

[3] "Bibliotheca Mathematica," Vol. 5_3, 1904, p. 85.

[4] *Philosophical Transactions,* No. 154, p. 399 (=Abridgment, Vol. I., 1705, p. 107).

[5] *Philosophical Trans. Abridged,* Vol. I., 1705, p. 108.

"oriental names"; it should refer to "Hindu-Arabic numerals." The alphabetical index is not as complete as one might wish it to be.

Florian Cajori

Colorado College,
Colorado Springs, Colo.

A Laboratory Course in Physiology. By Walter B. Cannon, A.M., M.D., George Higginson professor of physiology in the Harvard Medical School. Second edition. Published by Harvard University. 1911.

This is the set of loose-leaf laboratory notes and directions used in the course in physiology in the Harvard Medical School. It belongs to a class of works which have only begun to appear in recent years. It is not a general laboratory manual like the well-known handbook of Burdon Sanderson, or that of Stirling. Its scope is much narrower. While these works aimed to give, within the limits of their size, accounts of all ordinary physiological methods, the work before us, on the contrary, is merely a precise description of a particular course. Accordingly, it is limited to such methods as the facilities of the Harvard School allow. Within these limitations, however, it is excellent. It has already been adopted as the basis of the physiological course in a number of other institutions and contains much that is valuable and suggestive for the teaching of physiology anywhere.

The most striking defect of this "course" is that it contains far too much of the physiology of the frog and too little of the mammal. For the medical student direct personal experience in working with the circulation in one living cat or dog is worth two or three experiments upon the frog's heart, and a dozen upon the frog's leg. It is most unfortunate that the limitations which misguided humanitarians and anti-vivisectionists place upon the supply of cats in Boston should make it necessary to have the circulation in this animal worked out by the students in *groups of twelve.* This certainly falls far short of the important educational principle urged by Pearce that "the students should do it themselves." The reviewer knows from personal experience that the largest number of students who can possibly take part in a blood-pressure experiment on one cat is five. If mammalian material were as abundant as it ought to be for such a course, the work on the frog here outlined could profitably be cut in half. Each group should number four or five students instead of twelve and should have, instead of one cat, six to ten.

Much of the work on the frog here given could be profitably replaced by experiments on man. Simple sphygmomanometers can be provided cheaply, and should be used for experiments on the students themselves on a much more extensive scale than is outlined in these notes.

The weakest point in the notes is the section on respiration. Only eight pages are devoted to this subject, while muscle nerve physiology receives eighteen. The progress in knowledge of respiration within recent years, for which we are indebted principally to Haldane and his pupils, has been made largely by experiments upon man. These experiments are ideally suited to a laboratory course. Among them may be mentioned that of voluntary forced breathing and the succeeding apnœa; that of the artificial production of Cheyne-Stokes breathing requiring for its demonstration merely a tin of soda lime and a long tube; and that of the duration of the voluntary holding of the breath without preparation, after forced breathing, after oxygen and after forced breathing and oxygen.

These, however, are merely criticisms of detail. In general this work is certainly by far the best of its kind that has yet appeared. No other educational institution in America, perhaps none in the world, in recent years has made so many valuable experimental contributions to the theory and methods of teaching as has Harvard. Among these contributions not the least valuable is the demonstration that science in general and physiology in particular can be, and ought to be, taught by laboratory methods. Originally conceived by Huxley and first practised in this country by Newell Martin at Johns Hopkins and by the

late Professor Bowditch at Harvard, this idea has finally developed in the hands of the latter's successor into the work before us. It has the particular merit of making available everywhere the results of twenty years of experience in the teaching of physiology at the Harvard Medical School.

Yandell Henderson

Yale Medical School,
New Haven, Conn.,
February 27, 1912

PLEISTOCENE MAN FROM IPSWICH (ENGLAND)

So much has been said in the public press concerning a human skeleton of reputed great antiquity recently found near Ipswich, England, that a request from the editor of Science alone sufficed to cause me to alter my original decision not to write anything on the subject until after I had seen the skeleton as well as the locality from which it came. On receipt of communications from Mr. J. Reid Moir, who found the remains and from Professor Keith, who is making a detailed study of them, it is possible for me to comply with the request without further delay.

The main facts are these. On October 6, 1911, Mr. J. Reid Moir, of Ipswich, was notified by Messrs. Bolton and Laughlin, local brickmakers, that one of their workmen, while removing surface clay to reach the underlying glacial gravel, had encountered human bones. Mr. Moir proceeded at once to the pit and found that a portion of a human skull still attached to a complete encephalic cast of boulder clay had been recovered. Recognizing the importance of the find, Mr. Moir removed the remainder of the skeleton in the presence of three gentlemen, Messrs. Woolnough (curator of the local museum), Canton, and Snell. In order to preserve the extremely fragile bones, the containing beds were removed with them. After this had been done, three geologists, Dr. J. E. Marr, F.R.S., Mr. W. Whitaker, F.R.S., and Mr. George Slater, F.G.S., were called to Ipswich to examine the section.

A sheet of hard chalky boulder clay of varying thickness is spread over East Anglia, overlying stratified mid-glacial sands. Between these deposits and at a depth of only four and one half feet the skeleton was found. Was it interstratified? This question will probably never be answered to the satisfaction of all. According to Mr. Moir, a "most careful examination of the section before the disinterment took place showed clearly that no signs of any previous digging were visible, the clay above the skeleton appearing to be in every way the same as that which extended for some distance on each side of it." The presence of a calcareous band immediately underneath the skeleton was noted as well as the fact that it "extended more or less continuously on either side of the spot where the remains were found"; and it is pointed out by Mr. Moir that if a grave had been dug through the boulder clay, rain water percolating through the loose grave filling would have dissolved away the calcareous deposit. One of the best bits of evidence is that the skeleton was partly embedded in glacial sand and partly in boulder clay; "this sand showed clearly lines of stratification and was conformable with that underlying it."

On the other hand Mr. George Slater, one of the three geologists called to view the place, but not until after the bones had been removed to London, looks upon the site as highly unsatisfactory. Considering the loss by infiltration he would not expect to find distinct signs of a grave after a lapse of some thousands of years. The position on the side of a valley points to the possibility of hill wash or re-deposited boulder clay.

It was a wise precaution from every point of view to remove the matrix with the skeleton. This was done in blocks which were forwarded to Professor Arthur Keith at the Museum of the Royal College of Surgeons, London. Here each block was impregnated with a solution of gelatine, after which the bones were exposed by piecemeal removal of the overlying boulder clay, but were still left in situ on the underlying glacial sands. According to Professor Keith the whole skeleton was represented, its various parts being in

their proper position one to the other. It rested on its right side with the head bent forward, so as almost to reach the knees. The right arm was flexed beneath the body, the right hand resting under the right leg. The left arm was even more acutely flexed, with the elbow gripped between the knees and the left hand turned against the left shoulder. That the position of the Ipswich skeleton resembled somewhat the contracted posture so common to neolithic burials was recognized by Professor Keith, who believes, however, that this position does not necessarily mean burial; in other words, that it could have been assumed by the body at death without the intervention of intentional forces.

The right side of the skeleton in contact with the glacial sands was much better preserved than the left. The latter being embedded in the boulder clay, was most subjected to the destructive effects of roots as well as the action of the clay itself. The roots even penetrated the glacial sands and their effects on the skull and pelvis were marked. The corroding effects of the boulder clay (sandy, chalky loam) played havoc with the soft spongy portions of the skeleton, which are now represented by dense clay with here and there fragments of bone. The only complete bones recovered were those of the right hand.

The skeleton is that of a man about five feet ten inches in height and forty to fifty years of age. In addition to the complete brain cast (of boulder clay) there remain a "fragment of the frontal bone sufficient to show the characters of the forehead, parts of both temporal bones, with the joints of the mandible, and fragments of the parietal and occipital bones."[1] Nine of the teeth were recovered; these differ in no way from the teeth of neolithic man. Judging from the skull fragments and the brain cast, Keith concludes that the head did not differ essentially from that of modern Europeans except that the maximum width of the skull is situated rather far back, recalling in this respect alone the Neanderthal race. With the exception of the lower leg bones (tibia and fibula) and the upper arm bone or humerus, the limb bones are of the modern European type. The tibia lacks the sharp anterior crest or shin of modern man, and in this suggests the Neanderthal type, but not in respect to size and general shape.

If the skeleton does not represent a burial and if the chalky sandy loam at this point is a part of the original mantel of boulder clay, then the man of Ipswich is the earliest yet found with the exception of *Homo heidelbergensis* (*Pithecanthropus* not being considered as *Homo*). It would correspond to the latest eolithic horizon, the so-called Mesvinian, and would thus be somewhat older than the man of Galley Hill, provided the latter is properly dated. But as I pointed out in a recent article[2] there is room for doubt as to the age of the Galley Hill skeleton. From the foregoing account it would seem that the age of the Ipswich skeleton is also still an open question. The importance of having expert witnesses present at the disinterment in discoveries of this class was perhaps never better exemplified than at Galley Hill and Ipswich. Their absence will, it is feared, always leave the shadow of a doubt as to the age of the skeletons in question; and doubt is a serious handicap in matters of such scientific import. If both these specimens are correctly dated, then there lived as contemporaries in Europe for a long space of time two somatologically distinct races—a primitive type represented by the Mauer mandible, Neandertal, Spy, Chapelle-aux-Saints, La Quina, etc.; and a modern type represented by Ipswich, Galley Hill, and possibly Bury St. Edmunds. This is by no means impossible, in fact might have been the case. Either Ipswich or Galley Hill would alone be sufficient to prove it so, if all doubt as to age were removed. Until the full reports of Professor Keith, Mr. Moir, and the three geologists have been published, final

[1] From the report of an "inquest" in Ipswich February 21, which according to Mr. Moir gives "a very good account of the human remains" he had found.

[2] "Somatology and Man's Antiquity," *Records of the Past*, X., 329, November–December, 1911.

judgment on the Ipswich case must of course be suspended. If the modern type of man did actually live in Mindel-Riss interglacial times, a Pliocene chipper of flint would certainly not look out of place.

GEORGE GRANT MACCURDY
YALE UNIVERSITY,
NEW HAVEN, CONN.

THIRD LIST OF GENERIC NAMES FOR THE "OFFICIAL LIST OF ZOOLOGICAL NAMES"

9.[1] The following generic names of animals reported as parasites of man have been submitted to the International Commission on Zoological Nomenclature, by the Helminthological Society of Washington, for *inclusion* in the "Official List of Zoological Names":

CESTODA:

Davainea R. Blanchard & Railliet, in R. Bl., 1891*t*, 428–440, type *proglottina* (in chickens; France).

Diplogonoporus Lœnnberg, 1892*a*, 4–16, type *balænopteræ* (in *Balænoptera borealis;* Finmarken).

Dipylidium Leuckart, 1863*a*, 400, type *caninum* (in dogs; Europe).

Echinococcus Rudolphi, 1801*a*, 52–53, 55, type *granulosus* (in sheep; Europe).

Tænia Linnæus, 1758*a*, 819–820, type *solium* (in *Homo;* Europe).

NEMATODA:

Ancylostoma[2] [Dubini, 1843*a*, 5–13] emendation Creplin, 1845*a*, 325, type *duodenale* (in *Homo;* Italy).

Ascaris Linnæus, 1758*a*, 644, 648, type *lumbricoides* (in *Homo;* Europe).

Dracunculus "Kniphof, 1759, 12" [not verified]; Gallandat, 1773*a*, 103–116, type *medinensis* (in *Homo*).

Gnathostoma Owen, 1836*f*, 123–126, type *spinigerum* (in *Felis tigris;* London).

Necator Stiles, 1903*y*, 312, type *americanus* (in *Homo;* U. S. A.).

Strongyloides Grassi, 1879*f*, 497, type *intestinalis* = *stercoralis* (in *Homo*).

Trichostrongylus Looss, 1905*o*, 413–417, type *retortæformis* (in *Lepus timidus;* Europe).

[1] Paragraphs are numbered continuously with the earlier lists.

[2] See Art. 19, and Opinions 26, 27, 34 and 36.

GORDIACEA:

Gordius Linnæus, 1758*a*, 644, 647, type *aquaticus* (free; Europe).

Paragordius Camerano, 1897*g*, 368, 399–402, type *varius* (free; U. S. A.).

ACANTHOCEPHALA:

Gigantorhynchus Hamann, 1892*d*, 196, type *echinodiscus* (in *Myrmecophaga jubata, M. bivittata;* Brazil).

10. The undersigned secretary presents the following generic names for definite *rejection* from the "Official List," on the ground that they are preoccupied (see Art. 34):

TREMATODA:

Acanthocephala Dies., 1858, not Laporte, 1832.
Acrodactyla Staff., 1904, not Hal., ante 1846.
Anadasmus Looss, 1899, not Walsingham, 1897.
Anisogaster Looss, 1901, not Deyr, 1863.
Astia Looss, 1899, not Koch, 1879.
Baris Looss, 1899, not Germ., 1817.
Brachymetra Stoss., 1904, not Mayr, 1865.
Creadium Looss, 1899, not Vieill., 1816.
Crossodera Duj., 1845, not Gould, 1837.
Eurycælum Brock, 1886, not Chaudoir, 1848.
Eurysoma Duj., 1845, not Gistl., 1829.
Leioderma Staff., 1904, not Will.-Suhm, 1873.
Leptalea Looss, 1899, not Klug, 1839.
Leptosoma Staff., not Leach, 1819.
Levinsenia Stoss., 1899, not Mesnil, 1897.
Macraspis Olss., 1868 or 1869, not McL., ante 1835.
Megacetes Looss, 1899, not Thomas, 1859.
Microscapha Looss, 1899, not LeConte, 1866.
Polyorchis Stoss., 1892, not Agassiz, 1862.
Polysarcus Looss, 1899, not Fieb., 1853.
Spathidium Looss, 1899, not Duj., 1841.
Stomylus Looss, 1899, not Fahræus, 1871.

NEMATODA:[3]

Acanthophorus Linst., 1876, not Serv., 1832.
Acanthosoma Mayer, 1844, not Curt., 1824.
Aspidocephalus Dies., 1851, not Motsch, 1839.
Brachynema Cobb, 1893, not Fieb., 1861.
Cephalacanthus Dies., 1853, not Lac, 1802.
Cephalonema Cobb, 1893, not Stimps, ante 1882.
Chætosoma Claparède, 1863, not Westwood, 1851.
Cheiracanthus Dies., 1838, not Agassiz, 1833.
Cochlus Zed., 1803, not Humph., 1797.
Conocephalus Dies., 1861, not Thunb., 1812.

[3] This list contains a few names of organisms which are not Nematoda, but which have been classified as such at one time or another.

Cystocephalus Rail., 1895, not Léger, 1892.
Diceras Rud., 1810, not Lam., 1805.
Dipeltis Cobb, 1891, not Pack., 1885.
Discophora Vill., 1875, not Boisd., 1836.
Eucamptus Duj., 1845, not Chevr., 1833.
Eurystoma Marion, 1870, not Raf., 1818.
Fimbria Cobb, 1894, not Bohadsch, 1761.
Hoplocephalus Linst., 1898, not Cuv., 1829.
Leptoderes Duj., 1845, not Serv., 1839.
Litosoma Ben., 1873, not Douglas & Scott, 1865.
Mitrephorus Linst., 1877, not Schoenherr, 1837.
Oxysoma Schneid., 1866, not Gerv., 1849.
Oxystoma Buetschli, 1874, not Dum., 1806.
Oxyurus Lam., 1816, not Raf., 1810.
Paradoxites Lindem., 1865, not Goldf., 1843.
Pelodytes Schneid., 1860, not Fitz., ante 1846.
Pterocephalus Linst., 1899, not Schneid., 1887.
Ptychocephalus Dies., 1861, not Agassiz, 1843.
Rhabdogaster Metschnikoff, 1867, not Loew., 1858.
Rhabdonema Leuck., 1883, not Kuetzing, 1844.
Rhabdonema Perr., 1886, not Kuetzing, 1844.
Rhytis Mayer, 1835, not Zed., 1803.
Spilophora Bast., 1865, not Bohem., 1850.
Spinifer Linst., 1901, not Raf., 1831.
Spira Bast., 1865, not Brown, 1838.
Spirura Dies., 1861, not E. Bl., 1849.
Trichina Owen, 1835, not Meig., 1830.
Trichoderma Greef, 1869, not Steph., 1835.
Trichodes Linst., 1874, not Herbst, 1792.
Triodontus Looss, 1900, not Westwood, 1845.
Tropidurus Wiegm., 1835, not Neuwied, 1824.
Tropisurus Dies., 1835, not Neuwied, 1824.

GORDIACEA:
Paragordius Montgomery, 1898, = Camerano, 1897.

ACANTHOCEPHALA:
Arhynchus Shipley, 1896, not Dejean, 1834.
Neorhynchus Ham., 1892, not Sclater, 1869.

11. The names in question are published for the information of all persons interested. Objection to the proposed action should be filed with the undersigned secretary not later than January 1, 1913, together with ground upon which objection is based.

12. The above names will be forwarded immediately to the International Commission on Medical Zoology, and to the special subcommittees in the groups in question for special report.

13. The list will be forwarded about July 1, 1912, to the International Commission on Zoological Nomenclature, and the secretary expects to call for a vote on these names at the next regular meeting of the commission, in the summer of 1913.

14. The secretary takes this opportunity to state that his policy is to bring into the list a number of names upon the adoption of which no difference of opinion seems to exist, and to reject a large number of preoccupied names, before he submits for study the names upon which differences of opinion are expressed by authors.

C. W. STILES,
on Zoological Nomenclature
Secretary International Commission

SPECIAL ARTICLES

ON THE ORIGIN OF A PINK-EYED GUINEA-PIG WITH COLORED COAT[1]

THE rediscovery of Mendel's law in 1900 with the immediate and striking verifications which it received from both animal and plant breeders gave great impetus to the mutation theory of De Vries, and secured wide acceptance of the idea advanced earlier by Galton and Bateson that new organic forms arise only as discontinuous variations, in the production of which continuous or fluctuating variations have no part. An extreme form of this idea has been ably advocated by Johannsen in his pure-line conception of heredity. This has met with a reception so hearty that it is now endangered chiefly by the zeal of its adherents, who seem to some of us to be carrying the doctrine to ridiculous lengths. They can see nothing but pure lines in heredity of any sort; selection is wholly rejected except as an instrument for the sorting out of genes. Possibly this is the correct interpretation of the action of selection, but if so it will be found necessary to invoke the existence of multiple and subsidiary genes to such an extent that continuous and discontinuous variation will become practically indistinguishable. I am inclined, therefore, to question the validity of

[1] In the investigation described in this paper the author was aided by a grant from the Carnegie Institution of Washington, for which grateful acknowledgment is here made.

a hypothesis which has to be carried to such lengths, and I think this view is shared by many whose experience in breeding work has been very extensive.

Webber has somewhere expressed the view, I am sure verbally and I think also in his publications, that sport variation is more likely to occur in connection with repeated selection and in the same general direction as the selection. This view, if correct, is highly important. A case which may be considered to support it has recently occurred in the breeding experiments in progress at the Bussey Institution.

In mice, rabbits and cats, a dull black variety occurs which is known by fanciers as blue. The optical effect called blue is in such cases the result of a diminished number of black pigment granules in the fur. Fanciers have long desired to obtain a similar variety among guinea-pigs, but thus far without much success. Some eight years ago I became interested in the problem and began experiments which have continued to the present time. Knowing that Andalusian blue fowls are heterozygotes of black and white, I tried to produce a similar modification in guinea-pigs by cross-breeding. I found that crossing black with white gave results which varied in character with the white strain used. A sooty or "Himalayan" albino strain which by other experiments was shown to transmit intense black pigmentation produced no diminution of black in the heterozygotes. A very lightly pigmented albino which was found to transmit light yellow ("cream") in crosses produced heterozygotes with a much duller black, but not of the desired blue tone. In other words, albinos in crosses with black were found to breed exactly like the colored strains from which they were extracted. As the cross with a cream strain had produced the lightest black animals thus far obtained, I confined my further experiments to crosses with this cream strain or with albinos derived from it. In each generation the lightest heterozygous blacks were crossed with the lightest creams (or albinos). By this process a very considerable reduction in the amount of pigment in the fur was secured. The hairs of the black individuals were now dull black at the tip only; elsewhere the hair was sooty cream colored, indicating a great quantitative reduction of the pigments, both black and yellow. These peculiar black individuals we may for convenience henceforth call "blue." Blue parents mated with cream ones have in the past two years produced 17 blue, 15 cream and 13 white young, the Mendelian expectation being 3 blue: 3 cream: 2 white, if all parents are heterozygous for albinism. In a mating of this sort a few weeks ago (December 2, 1911) a blue mother gave birth by a cream male to a female young one which closely resembles an albino, its coat being in general white and its eyes pink, but on the right side of its head and on the hips are spots of blue. As in the pink-eyed mouse, the color of the fur is decidedly pale. In the iris of each eye may also be seen a faint pigmented streak. It is noteworthy that the pink-eyed mouse also has traces of pigment in its eyes.

The genetic behavior of pink-eyed mice shows that the pink-eyed variation is due to modification (or partial loss) of some factor necessary for the production of the full pigmentation. This factor, however, is not the color factor (C) which albinos lack, nor the yellow (Y), brown (Br) or black (B) factors, nor yet the agouti (A) factor, since with each of these and without it the pink-eyed variation may form distinct combinations. For the same reason it can be shown to be distinct from the condition of spotting with white.

It is noteworthy that the race of guinea-pigs in which the pink-eye variation has appeared is one in which a reduction of the amount of pigmentation was being attempted by a systematic selection, and was being actually obtained. The pink-eye variation would seem, therefore, to be merely a particular long step in the general course of modification which this race was undergoing directed by artificial selection. If so, it has probably been brought about by the modification of the *same* color factor or factors that have undergone modification in the blue race. This idea

will be put to an experimental test. If found correct, the suggestion will offer itself that a causal relationship may possibly exist between the *little* steps taken under selection, and the longer one appearing as a mutation.

The variation described in this paper made America on a collecting expedition. My associate, Mr. C. C. Little, was then in charge its appearance during my absence in South of the experiments. He at once recognized the importance of the variation from a theoretical standpoint and has given especial care to its preservation. For this I wish both to thank and to congratulate him. A less discriminating observer might easily have mistaken this animal for an albino with soiled fur.

W. E. Castle

Laboratory of Genetics,
Bussey Institution,
Forest Hills, Mass.,
February 8, 1912

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE SECTION B—PHYSICS

The annual meeting of Section B of the American Association for the Advancement of Science was held with the American Physical Society at the Bureau of Standards, Washington, December 27–30, 1911. Four forenoon sessions and three afternoon sessions were held. Of these, two were "general interest" sessions in charge of the officers of Section B and five were occupied with research papers, in charge of the American Physical Society. In all seventy-four papers were presented and one symposium held. Eight papers were presented by title only.

The presiding officers were Professor R. A. Millikan, vice-president of Section B, and Professor W. F. Magie, president of the Physical Society. At a short business session of the section Professor Theodore Lyman was elected to represent the section on the council, Professor C. E. Mendenhall a member of the sectional committee (for five years) and Professor F. A. Saunders a member of the general committee.

All sessions were held in a large laboratory of the Bureau of Standards. The attendance at several was about two hundred and for most others exceeded one hundred. It was probably the largest and most representative gathering of physicists ever held in America. In each of the three days when two sessions were held the scientific staff of the bureau generously provided a fine lunch for all in attendance.

The address of the retiring president of the association was of special interest to physicists this year. It was given on Wednesday evening in the assembly hall of the new National Museum by Professor A. A. Michelson on the subject "Recent Progress in Spectroscopic Methods."

On Friday evening a subscription dinner was given by the Philosophical Society of Washington in honor of Section B and the American Physical Society at the Shoreham Hotel. This was attended by about one hundred and was a most delightful occasion. Dr. E. B. Rosa, the retiring vice-president, acted as toastmaster and Professor A. A. Michelson, the retiring president of the association, was among the guests of honor.

Among the members of the association who were elected fellows by action of the council at this meeting are the following members of Section B: H. A. Wilson, Frank Wenner, Fay C. Brown, E. A. Harrington and W. J. Fisher.

The officers for the next annual meeting, to be held in Cleveland during the convocation week of 1912–13, are as follows:

Vice-president and Chairman of Section B—Professor A. G. Webster, Clark University.

Retiring Vice-president—Professor Robert A. Millikan, University of Chicago.

Secretary—Dr. W. J. Humphreys, U. S. Weather Bureau, Washington.

Member of Council—Professor Theodore Lyman, Harvard University.

Sectional Committee—R. A. Millikan, A. G. Webster, W. J. Humphreys, A. P. Carman, G. F. Hull, E. L. Nichols, A. Zeleny, C. E. Mendenhall and the president and secretary of the American Physical Society.

The two general-interest sessions in charge of Section B were held on Thursday, December 28. At the morning session Professor W. F. Magie, of Princeton, delivered the presidential address of the American Physical Society on "The Primary Concepts of Physics." This is given in full in the February 23 issue of Science. The remainder of the morning session was devoted to a symposium on "The Ether," led by Professor A. A. Michelson. Professors A. G. Webster, E. W. Morley, W. S. Franklin, D. F. Comstock and G. N. Lewis took part in the discussion. The significance and place of the principle of relativity was of course given principal attention and some difficulty was

experienced in finding common ground upon which to stand. At the afternoon session of the same day the retiring chairman of Section B gave his vice-presidential address upon "The Work of the Electrical Division of the Bureau of Standards." This is printed in full in the January 5 number of SCIENCE. Then followed an address by Professor H. A. Wilson, on "The Structure of the Atom," and by Director S. W. Stratton, on "The Work of the Bureau of Standards."

The following are abstracts of these addresses:

The Structure of Atoms: Professor H. A. WILSON, McGill University.

The essential constituent of matter appears to be electricity; recent researches, experimental and theoretical, suggest that electricity is in fact the only constituent of matter.

Free negative electrons can be obtained from almost any form of matter by heating, by the action of ultra-violet light or in other ways. The optical properties of matter are now explained by the presence of negative electrons; the Zeeman effect and dispersion may be specially mentioned. Many of the electrical and thermal properties of metals have been satisfactorily explained by supposing that metals contain negative electrons which move about inside them like the molecules of a gas.

Negative electrons must therefore be regarded as a universal constituent of all forms of matter. These electrons, moreover, are with good reason believed to be simply minute particles of negative electricity of much less than atomic size.

Electrically neutral matter must contain as much positive electricity as negative; it is clear, therefore, that all matter must also contain positive electricity. One of the most important results of recent electrical researches is the fact that while free negative electrons can be easily obtained from any kind of matter, positive electricity is always associated with at least one atom and never appears in the form of positive electrons. Positively charged molecules seem to be in all cases the result of the removal of negative electrons from neutral molecules. Since it appears that all negative electricity is made up of equal particles and since it is very probable that any atom can be exactly neutral it follows that the amount of positive electricity in any atom must be an exact multiple of the charge of one negative electron. This makes it probable that positive electricity is also made up of equal parts, but so far they have not been obtained free.

The absence of effects due to the earth's motion relative to the ether can be explained on the electromagnetic theory if it is supposed that this theory covers all phenomena. This appears to be a strong argument in favor of the purely electrical nature of matter.

It will be convenient now to mention the chief electrical theories of atomic structure which have been proposed.

According to Sir J. J. Thomson, atoms consist of solid spheres of positive electricity inside which negative electrons move about freely. If the sphere is taken to be of uniform density then a negative electron is attracted towards the center with a force proportional to its distance from the center. The electrons of course repel each other. The electrons will distribute themselves uniformly throughout the sphere so as to neutralize it as completely as possible and can vibrate about their positions of equilibrium. According to Sir J. Larmor, atoms consist of a number of positive and negative electrons describing orbits about each other. There may be rings of electrons revolving round concentric rings. On this view an atom is a sort of small gaseous nebula without any sort of solid foundation.

A third theory recently adopted by Rutherford regards the atom as containing a nucleus of positive electricity with negative electrons outside it; probably describing orbits around it. On this view the atom is a sort of minute solar system. The positive nucleus will always require the same number of negative electrons to keep it neutral so that it provides a definite foundation fixing the identity of the atom. The same may be said of the sphere in Sir J. J. Thomson's theory.

I shall now proceed to very briefly review some of the evidence as to the nature of atoms that can be derived from different branches of physics and to consider how far the theories mentioned are consistent with it.

The most important property of atoms is their extraordinary stability in presence of each other. For example, the atoms in a compound molecule are very intimately associated and yet they preserve their identity even at the highest temperatures. The molecules in a gas are continually colliding violently with other molecules, yet the atoms are not destroyed. Negative electrons can be knocked out of atoms by the impact of rapidly moving particles such as the cathode rays and α rays, yet the atoms retain their identity and after regaining negative electrons are unaffected. Facts like these appear to be decisive against Sir J. Larmor's theory. On this theory we should expect

all mixtures of different substances to rapidly change into the same substance. There is in fact nothing in Sir J. Larmor's theory to account for the stability of atoms which according to any such theory would be broken up by collisions and could not preserve their identity in compound molecules. This theory fails to explain why free positive electrons can not be obtained while negative electrons are easily isolated. On the other two theories the stability of the atoms can be ascribed to the stability of the positive sphere or nucleus. When negative electrons are knocked out of the atom the excess of positive charge can only be neutralized by an equal number being replaced, which restores the atom to its original condition. Important evidence as to the nature of atoms is provided by the properties of gases interpreted according to the kinetic theory. The viscosity, rate of diffusion and other properties of gases seem to be best explained if the molecules are regarded as having a definite volume of radius about 10^{-8} cm. This is usually termed the radius of molecular action and two molecules which are separated by a distance greater than about 10^{-8} cm. can be regarded as having no appreciable action on each other. Similar conclusions can be derived from the theory of surface tension and many other phenomena. The energy necessary to remove a negative electron from an atom, for example, indicates that the positive and negative charges are about 10^{-8} cm. apart in the atom.

The most important evidence from the kinetic theory is derived from the ratio of the specific heat at constant pressure to that at constant volume. This ratio γ is equal, according to the theory, to $1 + 2/n$ where n is the number of degrees of freedom per molecule. For helium, neon, argon, krypton, xenon, mercury vapor and other gases $\gamma = 1.66$, which requires that $n = 3$. This means that when such gases are heated all the energy goes into the three degrees of freedom of translational motion of the molecules, so that the molecules acquire no energy of rotation or vibration. To explain this it appears necessary to suppose that the molecules behave like rigid smooth spheres. Such gases are therefore believed to be monatomic, each atom behaving like a smooth sphere. These gases, however, give spectra containing many lines so that it is certain that their atoms contain electrons which can vibrate. It is necessary to suppose that collisions between these atoms do not set their electrons in vibration, which seems to require the electrons to be protected in some way. This seems to be strongly in favor of Sir J. J. Thomson's theory and against the other two theories, for if the electrons were describing orbits outside it is hard to see how they could escape violent disturbance during a collision.

Gases like nitrogen, hydrogen and carbonmonoxide have $\gamma = 1.4$, which gives $n = 5$. This means that their molecules behave like smooth rigid solids of revolution. These gases are diatomic, so that it appears that the two atoms in the molecule are firmly fixed together. This can be explained on Sir J. J. Thomson's theory by supposing that the two positive spheres stick together and it can not be explained on the other two theories.

The theory of the constitution of chemical compounds seems to require the atoms in compound molecules to be firmly fixed together in definite relative positions. The numerous cases of stereoisomerism and optically active isomers seem conclusive as to this. Similar conclusions follow from the properties of crystals which can be explained in many cases by supposing the atoms combined in a definite way throughout the crystal so that the whole crystal is, so to speak, one large molecule.[1] The rigidity of many crystals requires the atoms to be firmly fixed together.

On Sir J. J. Thomson's theory two atoms can stick together if one or more electrons are transferred from one to the other. In this case they would attract each other with great force and we may suppose the positive spheres to be flattened up against each other by the pressure so as to form a rigid combination.

Sir J. Larmor's theory and Rutherford's planetary theory are difficult to reconcile with the idea that atoms become firmly fixed together in compounds and rigid solids. On such theories we should expect to have nothing but gases and liquids and only very simple compounds.

Another important property of solids is their impenetrability by gases. This seems to require the atoms to occupy nearly the whole volume. The compressibility of solids is not great and does not diminish much at low temperatures. If atoms were made up merely of electrons of very minute volume we should expect solids at very low temperatures to contract to a very small volume or at any rate to become easily compressible. This again is in favor of atoms with a definite volume of radius about 10^{-8} cm. as on Sir J. J. Thomson's theory. This argument is taken from the Faraday lecture for 1911 by Professor Richards, who puts

[1] See A. E. H. Tutton, "Crystallography," London, 1911.

forward many good reasons for the view that atoms have a definite volume and are compressible.

The number of negative electrons in atoms can be deduced from observations on the scattering of the β rays of radium or of Röntgen rays and in other ways, as Sir J. J. Thomson has shown. The results obtained indicate that the number is a small constant multiple of the atomic weight.

The scattering of α rays led Rutherford to adopt the idea of a positive nucleus, since some α rays are turned through a larger angle than can be explained by the electric forces due to a charge equal to that on one electron. It may be, however, that other forces besides ordinary electric force act on α rays when moving through matter. The α rays are helium atoms which have a radius about 10^{-8} cm., so that they probably only get through by displacing the atoms of the matter. If we suppose the positive sphere of one atom can not penetrate into that of another then the scattering of α rays by matter can probably be explained on Sir J. J. Thomson's theory.

The most interesting application of Sir J. J. Thomson's theory is the explanation which it affords of the relation between the atoms in series of similar elements like fluorine, chlorine, bromine, iodine. Sir J. J. Thomson supposes that the negative electrons in the sphere are arranged in concentric spherical layers and that each element in a series of similar elements is derived from the one before it by the addition of one more layer. The writer[2] has worked out this idea and shown that it is in approximate agreement with the atomic weights and that the number of electrons per atom can be deduced approximately from the atomic weights. The result obtained was that the number of electrons is about eight times the atomic weight.

Probably the most promising of the many ways of obtaining evidence as to the structure of atoms is by the study of the spectra of the light which they give out when set vibrating by different disturbing agencies. Most spectra, however, are so complicated that very little progress has yet been made. The fact that spectra contain lines of definite wave length suggests that the electrons in the atom vibrate about positions of equilibrium or else are moving in magnetic fields of constant strength. This seems to be a strong argument against theories of the planetary type, for on such theories the period of vibration is not fixed, but depends on the radius of the orbit.

Any theory which explains spectra ought also to explain the Zeemann effect.

[2] *Phil. Mag.*, June, 1911.

An important question is whether all the lines in the spectrum of an element can be emitted by each atom or whether the different lines are emitted by different systems. The second view now seems the more probable. On this view the different lines do not correspond to the different possible modes of vibration of each atom, but each line is due to the vibration of a different system. Of course a particular system may give more than one line in some cases. Thus we might suppose a regular series of n lines to be due to the vibrations of molecules with one, two, three up to n atoms in the molecule. Other series for the same element might be due to molecules which had each lost say m electrons with up to n atoms per molecule. On this view the frequency of vibration would be a function of two integers n and m. The different series in the spectra of the alkalies can be represented approximately as functions of two integers, as is well known.

The only theories of series spectra which have been developed to any extent are due to Ritz ("Gesammelte Werke W. Ritz," Paris, 1911). In his earlier papers he supposed the lines in each series to be due to different modes of vibration of an elastic membrane having special properties. Later he abandoned this view and supposed each line due to a different system.

Ritz's atomic vibrator consists of an electron vibrating in the magnetic field of a bar magnet at a point along its axis. The electron is supposed to stay close to a particular point on the axis and to vibrate in the plane perpendicular to the axis. The distance from the electron to the nearest pole is taken to vary by equal increments and the distance between the two poles also is supposed to vary by equal increments in going from one atom to another. This makes the frequency a function of two integers and the function found agrees approximately with the observed frequencies. However, to obtain exact agreement Ritz had to suppose the increments to be not always exactly equal. Ritz supposed the bar magnet to be made up of a row of nearly equal elementary magnets. In any atom some of the elementary magnets are in the row and the rest may be supposed arranged so as to neutralize each other.

This idea of elementary magnets receives some support from recent work on the magnetic properties of bodies by Weiss and others. The elementary magnets of course may consist of electrons moving round orbits.

It now seems probable that the formulæ proposed for the representation of series spectra are not quite exact and are consequently to be regarded as merely empirical and so without much real physical significance. Almost any function of integers containing four or five arbitrary constants will represent with accuracy a series of values which vary in a regular way.

Ritz's theory seems to the writer to be very artificial and altogether improbable.

In conclusion we may say that while we are still far from arriving at a complete theory of atomic structure yet some progress has been made in that direction. It is easy to get a theory which will explain any particular set of facts, but the same theory will not explain all the different sets of facts.

As to the bearing of radioactivity on this question reference may be made to a paper by J. W. Nicholson in the *Philosophical Magazine* for December, 1911. The serious objections to planetary theories pointed out above apply to his suggestions.

The Work of the Bureau of Standards: Dr. S. W. STRATTON, Director.

For purposes of administration, the Bureau of Standards is for the present divided into seven divisions. The first four are based somewhat upon the usual divisions of the subject of physics, the work consisting primarily in the solution of problems relating to standards of measurement, precision measuring instruments, methods of measurement and the determination of constants. They also investigate the properties of materials when the determination of such properties involves the services and equipment of the physicist rather than those of the engineer. The fifth division includes the principal chemical work of the bureau. The sixth division, having to do principally with engineering tests and investigations not ordinarily included in the four physical divisions, is scarcely organized as yet, except in certain lines of testing. The seventh division, the newest and largest in the bureau, relates to the investigation and testing of engineering, structural and miscellaneous materials. The various divisions are subdivided into sections, based upon the natural classification of their work, and sometimes upon the lines along which the experts specialize. The bureau is perhaps unique in bringing together the physicist, the chemist and the engineering investigator into closer relationship than at any other scientific institution in the country. Every effort is made to promote cooperation, even at the expense of organization if need be.

The act establishing the Bureau of Standards authorizes it to take up, in addition to the usual problems in connection with the physical units and standards, the determination of physical constants and the properties of materials, that is to say, Congress in enacting this law recognized the necessity for standard values of constants and standards of quality as well as standards of measurement. Uniform and accurate values of physical constants are as essential in scientific investigation, engineering work or commerce and trade as are uniform and reliable standards of length or mass. Similarly, well determined and defined properties of materials are equally important in the design of structures, the operation of machinery and the various mechanical uses of materials. A knowledge of materials is necessary for their most efficient and economical use. The problems awaiting solution in connection with the properties of materials are almost infinite in number; hence, the bureau's work in this direction will be confined for some time to come to those investigations which are necessary for the production of standard values or authoritative data.

Attention should be directed to certain phases of the bureau's work, which are of great importance and which might be called the "by-products" of the bureau. These are, furnishing to the public information acquired by the bureau in the exercise of its functions; the giving of information to the other bureaus and institutions of the government concerning physical, chemical and engineering questions involved in their work, and the giving of information to state and municipal governments and especially to public service commissions, which are becoming a very important factor in state legislation. The experts of the bureau are consulted in regard to scientific principles involved in the enactment of legislation and the establishment of regulations. At this time the bureau has in press several publications intended primarily for the assistance of state and municipal governments and public service commissions. Another important "by-product" is the influence that the bureau is exerting upon the development of scientific methods and the establishment of research laboratories in connection with our industries. The efforts of the bureau in connection with the work of these laboratories and in undertaking its own technical researches will always be directed toward basing such investigations on sound scientific principles, and to assist those industries in a wider and more efficient use of the scientific discoveries. Finally, through the efforts

and influence of the bureau it has been largely instrumental in bringing into closer cooperation the different national bureaus with a view to international agreement as to the fundamental questions involved in matters pertaining to standards.

The following seventy research papers were presented at the sessions of Wednesday, Friday and Saturday, in charge of the officers of the American Physical Society. Most of them will be published, either in abstract or in full, in the *Physical Review*.

"An Important Practical Problem in Gyrostatic Action," W. S. Franklin, Lehigh University.

"A Relation between the Magnetic Hysteresis and the Tensile Strength of a Series of Iron-carbon Alloys," C. W. Waggoner, West Virginia University. (Read by title.)

"Relation between the Joule Effect and the Permeability in the Same Specimens of Steel," S. R. Williams, Oberlin College.

"A Magnetic Test as a Means of Determining Flaws and Mechanical Strains in Iron and Steel," Chas. W. Burrows, Bureau of Standards.

"The Electrical Resistance and the Polarization E.M.F. of a Mixture of Clay, Feldspar and Quartz," A. A. Somerville and O. E. Buckley, Cornell University.

"A Kinetic Theory of Gravitation; Some Explanatory Remarks on my Paper of Last Year," Charles F. Brush, Cleveland.

"Some Diffraction Photographs," Mason E. Hufford, Indiana University.

"Demonstration of Linear and Surface Thermopiles of Bismuth and Silver," W. W. Coblentz, Bureau of Standards.

"The Vertical Temperature Gradient of the Atmosphere," Wm. R. Blair, Mount Weather Observatory, Bluemont, Va.

"A Modified View of Electronic Conduction," Walter P. White, Geophysical Laboratory.

"The Application of Statistical Principles to Photoelectric Effects and Some Allied Phenomena," O. W. Richardson, Princeton University. (By title.)

"The Velocity-distribution Curves of Electrons Liberated by Different Sources of Ultra-violet Light, and the Bearing of these Curves on the Planck-Einstein Theory," R. A. Millikan, University of Chicago.

"A Study of Crystal Rectifiers," R. H. Goddard, Clark University.

"The Half-value of the Radioactive Deposit Collected in the Open Air," F. A. Harvey, Syracuse University.

"Distribution of Current in Point-Plane Discharge," Robt. F. Earhart, Ohio State University.

"The Influence of Temperature on the Phenomena of Phosphorescence in Zinc Sulphide," H. E. Ives and M. Luckiesh.

"On the Free Vibrations of a Lecher System using a Lecher Oscillator, II.," F. C. Blake, Ohio State University. (Read by title.)

"The Thomson Effect in, and the Thermal Conductivity of Tungsten, Tantalum and Carbon at Glowing Temperatures," A. G. Worthing, National Electric Lamp Association, Cleveland.

"The Effect of the Electrical Discharge on Solids and Liquids Suspended in Air," W. W. Strong, University of Pittsburgh.

"A Quantitative Measure of Development in Scientific Observation," Otto Stuhlmann, Jr., Stevens Institute of Technology, Hoboken, N. J.

"Elastic Hysteresis in Metal Bars," A. G. Webster and T. L. Porter, Clark University.

"The Spectra of Iron and Titanium at Moderate Pressure," H. G. Gale, Chicago University.

"The Spark Spectra of the Alkaline Earths in the Schumann Region," Theodore Lyman, Jefferson Physical Laboratory, Harvard University.

"Demonstration of the Resonance Spectrum of Iodine in Vacuo and in Helium," R. W. Wood, Johns Hopkins University.

"A Convenient Device for Obtaining a Steady High Potential for Electrometer Work," A. H. Forman, Cornell University. Introduced by J. S. Shearer.

"The Form of CO_2, SO_2 and NH_3 Crystals," H. E. Behnken. (Introduced by J. S. Shearer.)

"A New Method of Photographing Sound Waves," A. L. Foley and W. H. Souder, Indiana University.

"Another Instrument for Photographing Sound," A. G. Webster, Clark University.

"The Influence of the Natural Periods of Concentrating Horn and Diaphragm upon Sound Wave Records, and the Quantitative Analyses of Tones from Several Musical Instruments," D. C. Miller, Case School of Applied Sciences.

"Slit Width Corrections in the Photometry of Black Body Spectra," E. P. Hyde, National Electric Lamp Association, Cleveland.

"The Effect of Temperature on the Absorbed Charge in Electric Condensers," Anthony Zeleny, University of Minnesota.

"The Influence of Neighboring Conductors upon

a Klemencic Receiver of Electric Waves,'' A. D. Cole, Ohio State University.

''The Absorption of Beta Rays by Gases,'' A. F. Kovarik, University of Minnesota. (Read by title.)

''The Absorption of Gamma Rays of Radium by Air at Different Pressures,'' H. A. Erikson, University of Minnesota.

''Poynting's Tangential Method for showing the Existence of Radiation Pressure an Assumption unwarranted by Experiment,'' R. A. Wetzel, College of the City of New York.

''A New Type of Curve Drawing Instrument and Controller Mechanism,'' M. E. Leeds, Philadelphia, Pa.

''The Silver Voltameter as a Precision Instrument,'' E. B. Rosa, Bureau of Standards.

''Recent Work with the Silver Voltameter,'' G. W. Vinal, Bureau of Standards.

''The Dielectric Constant, Specific Resistance and Electrostatic Absorption of Crystals,'' H. L. Curtis, Bureau of Standards.

''A New Type of Apparatus for Measuring Linear Expansion,'' Arthur W. Gray, Bureau of Standards.

''Temperature Influence upon the Refraction of Quartz, Boro-silicate Crown Glass, and Dense Flint Glass, from 100° C. to — 190° C.,'' F. A. Molby, Cornell University.

''Thermo E.M.F. of the Nernst Filament,'' J. S. Shearer, Cornell University.

''Diffraction Gratings with Controlled Groove and Anomalous Distribution of Intensity'' (illustrated with experiments), R. W. Wood, Johns Hopkins University.

''Further Investigations with the Radiant Emission from the Electric Spark,'' R. W. Wood, Johns Hopkins University.

''A New Type of Neutral Double Potentiometer,'' Walter P. White, Geophysical Laboratory.

''Note on the Ascensional Rate of the Free Balloons used for Meteorological Purposes,'' Wm. R. Blair, Mount Weather Observatory, Bluemont, Va.

''A Modified View of the Electron Theory of Thermoelectricity,'' Walter P. White, Geophysical Laboratory.

''A Simple Dynamical Example of the Genesis of an Integral Equation,'' A. G. Webster, Clark University.

''A New Way to Determine *g*,'' A. G. Webster, Clark University.

''On the Effect of Close Electrostatic Coupling on the Free Period of a Lecher System,'' F. C. Blake, Ohio State University. (Read by title.)

''Poynting's Theorem and the Equation of Electromagnetic Action,'' W. S. Franklin, Lehigh University.

''A Simple Slit for the Spectroscope,'' J. P. Naylor, DePauw University.

''The Applicability of the Planck Equation to the Radiation from Tantalum and Tungsten,'' E. P. Hyde, National Electric Lamp Association, Cleveland.

''Evidence that the Velocity of Light is Independent of the Motion of the Source,'' D. F. Comstock, Massachusetts Institute of Technology.

''The Specific Heat of Wood,'' Frederick Dunlap, Department of Agriculture, Washington.

''On the Relation between Pressure Displacement and Wave-length,'' W. S. Adams and H. G. Gale, University of Chicago.

''The Expansion of Water below 0° C.,'' J. F. Mohler, Dickinson College.

''The Transmission of the Active Deposit of Radium in an Electric Field,'' E. M. Wellisch, Yale University.

''A New Form of Vacuum Pump,'' J. Johnston, Geophysical Laboratory.

''The Emission of Light by Hydrogen Canal Rays,'' G. S. Fulcher, University of Wisconsin.

''A Sensitive Vacuum Thermal Couple and Method for Producing High Vacua,'' A. H. Pfund, Johns Hopkins University.

''On Magnetic Rays,'' L. T. More and E. G. Rieman, University of Cincinnati. (Read by title.)

''The Wave-Lengths of Neon,'' I. G. Priest, Bureau of Standards.

''The Electric Discharge from Pointed Conductors,'' John Zeleny, University of Minnesota.

''Ellipticity and Rotation in Optically Active Solutions,'' L. B. Olmstead, Bureau of Standards.

''The Language of Meteorology,'' C. F. Talman, Washington.

''The Joule Thomson Effect in CO_2,'' E. S. Burnett, Cornell University.

''On the Theory of the Hysteresis Loop of Iron,'' J. Kunz, University of Illinois.

''The Photo-electric Effect in Phosphorescent Materials,'' G. A. Butman, Yale University.

''An Absolute Determination of the Coefficient of Viscosity of Air,'' L. Gilchrist, Univ. of Toronto.

Alfred D. Cole,
Secretary of Section B, A. A. A. S.

Ohio State University